The Electrical World.

VOL. XXVII. NEW YORK, FEBRUARY 22, 1896. No. 8.

PUBLISHED EVERY SATURDAY, BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

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THE ELECTRICAL WORLD,

253 Broadway, New York.

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THE TELEPHONE.

The reported action of the United States Supreme Court in advancing the Berliner case on the calendar will serve a good public purpose, even should the final decision prove adverse to the public interest. In the latter event it is more than probable that litigation of the matter will be resumed, but under much more favorable circumstances than those which from the beginning have hampered the government suit. A somewhat amusing instance of the complications in which the government is sometimes involved on account of the protean character of its functions, is afforded by the account in another column of its embarrassing situation as a purchaser of telephones for use in the public service. Acting as prosecutor in the Berliner case, it cannot very consistently concede the points in suit by recognizing the claims of the Bell Company in the granular transmitter patent, and, on the other hand, it is confronted by adjudications in favor by its own federal courts. It is to be noted that Uncle Sam continues to use, unmolested, the telephones bought in open market, the owners of the patents alleged to be thereby infringed apparently considering that in this case discretion is the better part of valor. The revival of the Drawbaugh claims to the Berliner principle, noted in another column, recalls the days of the great Bell telephone litigation, when the same inventor unsuccessfully fought for years to annul the fundamental Bell telephone patent.

ACETYLENE GAS.

The New York *Sun* devotes a large amount of space in its issue of Feb. 16 to acetylene gas, the caption of the article being: "Beware of Acetylene Gas." The opening paragraph explains that the *Sun* desires to sound a warning note to all people who may be about to invest in the stock of companies formed to exploit the gas or the material from which it is produced. Elsewhere it is stated that somewhere between $20,000,000 and $30,000,000 of shares are to be put on the market within a few months. The prospective investor is advised to bear several pertinent facts in mind, as follows: First, that though Mr. Willson made his so-called discovery of the process of making calcic carbide several years ago, and the company which owns his patents has been in existence for about a year, yet to-day there is no commercial plant for the manufacture of the material in this country; second, that no one directly and responsibly connected with this company will give any guaranteed estimate whatever as to the cost of producing calcic carbide or acetylene gas; third, that the companies now about to be formed, and some now offering stock for sale, have no right to manufacture either the carbide or gas except for the production of light, heat and power, thus being deprived of any benefit that may accrue should the material, as claimed, prove of value in the manufacture of hydro-carbon substances. The article pronounces absurd a number of estimates, mostly prepared by interested persons and presented to the public with the endorsement of acetylene stock promoters, purporting to give the cost of manufacture of the carbide. As an example of the reliance to be placed upon statements made in this connection, and supposed to be derived from disinterested sources, Vivian Lewes, of England, is quoted as authority for the statement that calcic carbide can be manufactured at a cost of $20 per ton. In a recent paper, Mr. Lewes says: "The data as to cost, which have been from time to time supplied from America, vary in the most extraordinary way, and between extremes which are both equally ridiculous. I have information, which I believe to be reliable, to the effect that in Germany the carbide is being made at 170

marks per ton, or practically £8 10s. ($42.50), and experiments made in England point to the possibility of making it in bulk at about £9 10s. ($47.50) a ton. The figures are strengthened by the consideration that the Swiss Aluminum Company are selling it, packed in hermetically sealed tins, at 6d. per kilogramme, which means £25 ($125) a ton, and it is manifest that this could not be done if the cost of production were above one third of the selling price." At the Milwaukee meeting of the Northwestern Association an estimate was given of the cost of producing calcic carbide, based, it was stated, upon an estimate made by an official of the General Electric Company at the request of the Association of Edison Illuminating Companies, the figure being $25.15 per ton, "not considering any by-products, such as lime, which can be used over again." In the *Sun* the estimate of the said official is printed in detail, but the total cost of producing one ton of calcic carbide he calculated at $84.50 per ton, to which "must be added cost of handling, shipping, extracting and storing gas." In view of the manner in which acetylene gas was "boomed" at the recent meeting of the Northwestern Electrical Association, it would seem advisable for that body to adopt the practice of professional societies in requiring papers submitted for reading to undergo the scrutiny of an editing committee. While it thus seems little probable that acetylene gas will prove a competitor to electricity for lighting or power, it may yet find application in the chemical arts in the manufacture of hydro-carbon compounds, and in a recent communication presented to the French Academy, M. Chatelier points out another field of usefulness, though perhaps a restricted one. This savant found that if acetylene gas is burned with an equal volume of oxygen, the flame has a temperature of 4000 degrees Centigrade, or 1000 degrees higher than that of the oxy-hydrogen flame; moreover, the products of combustion being entirely formed of the oxides of carbon and of hydrogen, the flame is strongly reducing in its effect. The same note conveys the information that acetylene gas ignites at a temperature more than 216 degrees Fahrenheit below the temperature of ignition of ordinary illuminating gas, which adds still another to its disadvantages as an illuminant.

RÖNTGEN RAYS.

Up to the present the nature of the Röntgen phenomenon remains as much a mystery as when its effects were first discovered. Indeed, their startling peculiarity is accentuated by a recent announcement of J. J. Thomson, to the effect that the rays cause all substances through which they pass to become for the time being conductors of electricity. Cathode rays, it will be remembered, have the property of dissipating a charge of negative electricity on a plate which they strike, but Prof. Thomson found that the new rays discharged positive as well as negative electricity, and this whether the electrified plate is embedded in paraffin, or other insulating substance. Dr. Lodge has made a careful examination of the various hypotheses offered to explain the Röntgen effect, but without coming to any definite conclusion, beyond the assertion that he is convinced from experimental evidence that the hypothesis of a stream of electrified particles is untenable. On the other hand, he believes that the hypothesis of a simple molecular stream—not electrified—remains a possibility, thus refusing to entirely abandon the English theory of radiant matter, which, it may be remarked, has never received much favor from Continental physicists. In regard to the wave hypothesis, Dr. Lodge considers that the vibrations of the ether set up are not necessarily longitudinal, but may be transverse; in the latter case, however, they will be of much smaller length than any transverse waves hitherto known, and therefore extending far up into the ultra-violet part of the spectrum. Longitudinal waves he speaks of as ethereal sound vibrations, and adds that they may reasonably also be styled gravitational waves. The classical Cavendish-Faraday-Maxwell experiments establishing the incompressibility of the ether are declared not to be of weight in the present instance, should the longitudinal wave velocity be as great as seems probable. Dr. Lodge acknowledges the great force of the arguments in favor of the longitudinal wave hypothesis, but considers that there is yet plenty of scope for further experiment, and that a few weeks may be sufficient to intensify our convictions in respect to one or the other of the present hypotheses, or new facts may cause opinions to take directions not yet thought of. As to the origin of the rays, Poincaré asserts positively that they are generated from cathode rays at the surface of the glass of a vacuum tube. This view receives additional support from a recent experiment of J. J. Thomson, in which it was found that no impression was received on a sensitive plate from an object when both were enclosed in a vacuum tube in the path of cathode rays. The evidence that Röntgen rays are not cathode rays seems to be absolutely established, and, therefore, the name of *cathodographs* for shadow pictures is both wrong and misleading. Dr. Lodge, in England, and Prof. Goodspeed, of the University of Pennsylvania, have both used the word *radiograph* for such pictures, and the word *skotograph* (shadow writing) has been proposed by Mr. Max Osterberg. An objection to the former name arises from its generality, as it also includes photographs, while the knowledge of the Röntgen effect would appear as yet too limited to definitely fix upon the latter word at present. One of the most important developments with respect to the Röntgen phenomenon made in this country during the past week was the discovery by Mr. Edison that the slowest photographic plates are most sensitive to the new rays, and *vice versa*. It was found, for example, that a greater effect was produced in two minutes with a slow landscape plate than in ten minutes with an instantaneous plate. Dr. Henry Leffermann, of Philadelphia, has recently made some experiments which confirm those of Dr. Pupin, noticed in our columns last week, showing that shadowgraphs may be obtained from ordinary light if the exposure is sufficiently long and the opaque cover over the sensitive film not too thick. Dr. Leffermann in this manner obtained shadowgraphs after ten hours' exposure by the percolation of light through heavy cardboard, and at Columbia College similar "light" shadowgraphs were obtained in even less time of an object upon the ebonite cover of a plate holder exposed to sunlight. It is needless to say that these effects can be explained by the well-known fact that light will pass in small quantities through apparently opaque substances, and therefore an assumption in regard to the presence of Röntgen rays in the light of the sun or of the electric arc is not justified.

"Light" Shadowgraphs.

We are informed by Dr. Pupin that the experiments on photography through opaque bodies by means of arc and sunlight, now being carried on at Columbia College, are under the direction of Mr. W. H. Freedman, tutor in the Department of Mechanics, and that Mr. Freedman is also searching diligently for the purpose of detecting the presence of Röntgen rays in other sources of light besides the luminescence in vacuum tubes.

Mathematical Notation.

In a letter to *Science* on the subject of quarternions, Prof. Alexander Macfarlane, of Lehigh University, refers to the great advance in electrical theory which, he says, has been due in a large measure to the practical manner in which electricians have discussed the principles and definitions of their science, finally settling all definitions by an authorized congress. It having been proposed to form an "International Association for Promoting the Study of Quarternions and Allied Systems of Mathematics," Prof. Macfarlane says that doubtless this association would eventually accomplish an equal good in its line, and adds that electricians, being alive to the importance of this branch of higher mathematics, the indications are that they will have much influence in the settlement of questions thus brought up. He recommends that the notation of quarternions be built up on an adequate analysis if it is to be lasting, and refers to the 4π muddle in the system of electric and magnetic units as a warning that should lead to making haste slowly.

An Electric Ship.

Senator Hill has introduced into Congress a bill authorizing the Secretary of the Navy to construct cruisers after the design of Richard B. Painton, in which electricity will be used as power. The inventor claims that with this system he can develop a speed of 40 knots an hour in an ordinary passenger ship and 35 knots an hour in a naval ship, under the usual conditions of sea and wind. The vessel on this system will have 14 screw propellers arranged along the side, each to be independently operated from a switchboard. There are two propellers forward and aft at regular intervals. The other propellers are located on each side of the ship. The two stern propellers are located under the overhang of the stern. Each forward and aft propeller consists of two wheels so arranged on the shaft that the blades of the forward wheel are opposite the opening between the blades of the after wheel. The inventor states that with this system 1800 revolutions have been reached in practice and 800 can be depended upon in service. He says that he can reduce the loss of transmission of power in a 20,000 horse-power ship from 6600 to 2000 horse-power. Each propeller is to be worked by a separate motor, current being generated for the various motors by a central generating plant. To increase the speed of a vessel from, say, 20 to 40 knots, the horse-power will be increased but little less than eight times. As the propulsion efficiency of present vessels is at least 55 per cent., therefore it follows that Mr. Painton's system, assuming for it a propulsion efficiency of 100 per cent., implies that the combination of steam and electrical machinery has an efficiency about four times greater than that of steam engines applying their power without the intermediary of dynamos and motors.

Susquehanna Water-Power.

It is reported that plans have been completed by Mr. Clemens Herschell for a water-power plant on the Susquehanna River near Maryland. Mr. Herschell says that a minimum of 5000 horse-power will be produced, and it is claimed that a 45-foot fall can be secured which would run the power up to 100,000 horse-power. The report states that Messrs. Elkins and Widener, of the Philadelphia Traction Syndicate, and other Philadelphia, Pittsburg and Baltimore capitalists are interested in the scheme.

Defective Wiring.

An employee in a workshop at Winchester, Mass., was instantly killed last week while in the act of lighting an incandescent lamp. Recently several other employees had received severe shocks while turning on lights, and later on the same day that the employee was killed the fire department was called out to extinguish a fire in the shop, which is supposed to have been caused by electricity. It is claimed by the owner of the shop that the local electric company had failed to investigate the wiring of the shop after it had been found defective, notwithstanding repeated requests.

Van Depoele Trolley Patents.

Suit has been brought at New Haven, Conn., by the General Electric Company, asking for an injunction against the Electrical Specialty Company, of New Haven, and the Billings & Spencer Company, of Hartford, to restrain them from manufacturing the Van Depoele underrunning trolley. An injunction was also served on the Elmira Municipal Improvement Company, of Elmira, N. Y., to prevent its use if infringing trolley appliances.

Röntgen Rays.

Mr. Edison has more recently been devoting his attention to determining the most desirable form of tube, the proper current and the sensitive photographic plate best adapted to the Röntgen rays. The latest form of tube employed, and which will be used in projected experiments, is shown in Fig. 1. The bulb is a modified incandescent lamp bulb mounted on a pedestal constructed of cork, glass and ebonite. It has been found by experiment that a vacuum of 1/200,000 of an atmosphere gives more satisfactory results than either a greater or less vacuum, and that a disruptive current of 213 periods per second is better than one of 40 to the second, which were employed in earlier experiments. Fig. 2 is the reproduction of a sketch made by Mr. Edison to show the disposition of apparatus. Continuous current is taken from the lighting mains, and a disruptive current produced by means of a disc with alternate conducting and insulating surfaces on its circumference, the disc being driven by the motor on the left.

An interesting series of experiments was made to determine the effect of the rays on photographic plates of various degrees of sensitiveness. The plates ranged from the most rapid employed in instantaneous work to slow landscape plates. The plates were cut into strips about ¼ of an inch in width, and five of different sensitiveness were placed together. Over these were placed a piece of ½-inch ivory, and three strips of ½-inch steel attached to pieces of cardboard 3-52ds of an inch in thickness. These were placed in the plate holder and exposed to the rays for 10 minutes, the bulb being four inches away from the slide of the plate holder.

When developed the sensitive strips showed conclusively that the

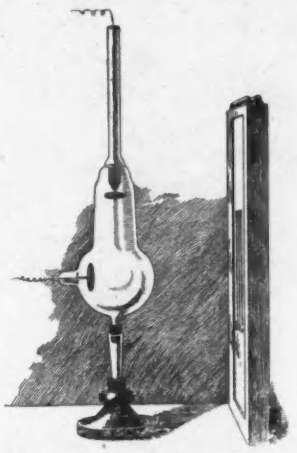


FIG. 1.—VACUUM TUBE AND PLATE HOLDER.

most rapid plates, or those most sensitive to the sunlight, were least sensitive to the rays from the bulb. As shown by the three dark lines in the illustration the steel strips were not penetrated by the rays; the ivory, on the contrary, was quite transparent to them. Mr. Edison considers this of great importance, as ivory, being of much greater density than the bone structure of the skull, the latter might be easily penetrated. On one of the experimental plates the lines showing the steel strips were much stronger in the upper than in the lower part of the plate. This was thought to be due to the rays being cut off from the lower part of the plate by the corner of the block upon which it rested, and Mr. Edison believes this shows that the rays are radiated in straight lines, as claimed by Röntgen, Fig. 3 is a photographic reproduction of the strips referred to, with another added; the latter was a slow or landscape plate, and though exposed but two minutes was more affected than some of the rapid plates after an exposure of 10 minutes. An expert in photographic matters will make his headquarters at the laboratory this week with

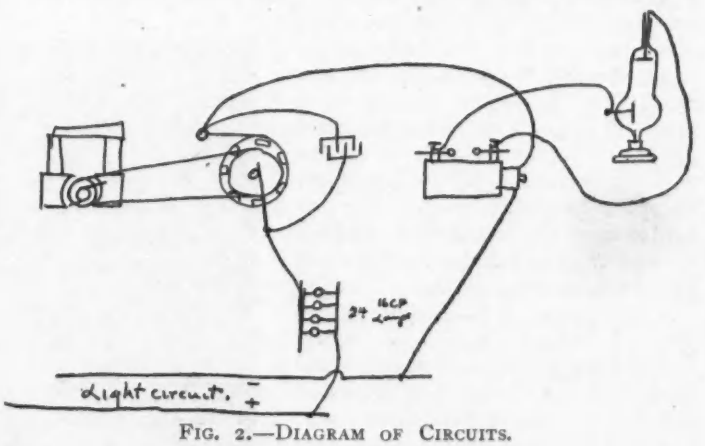


FIG. 2.—DIAGRAM OF CIRCUITS.

the necessary materials for making plates of the different degrees of sensitiveness. The five plates are arranged in order of sensitiveness, the quickest plate at the top.

Mr. Edison has taken up the investigation of the effect of Röntgen rays on platino-cyanide of barium, from which he expects good results. Trouble is experienced, however, in the preparation of the sensitized plates with this emulsion, owing to the deadly character of its fumes, which renders it necessary for the manipulator to work with a closed mask over his face, connected to a breathing tube leading to the outer air.

An Italian scientist has announced that if a plate is covered with

this emulsion, and the hand, for instance, interposed between such a plate and the source of Röntgen rays, the parts of the plate from which the rays are not intercepted in their passage will fluoresce strongly; the fluorescence is less from the rays that pass through the flesh of the hand and absent entirely from the surface shielded by the bones. As a consequence, a well-defined image may appear on the plate, and be viewed directly.

Prof. Edwin B. Frost, of Dartmouth College, has succeeded in

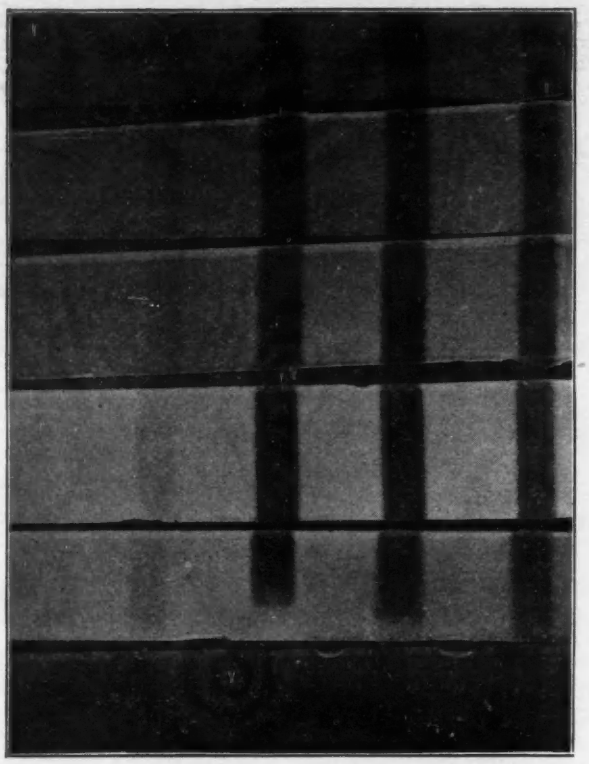


Fig. 3.—Showing Relative Sensitiveness of Photographic Plates.

taking one of the best shadowgraphs yet made in this country, a reproduction of which, from an illustration in *Science*, we print in another column. (Fig. 4.) Prof. D. W. Hering, of the University of the City of New York, has had remarkable success in procuring sharply defined pictures, which equal those of Prof. Röntgen. In our next issue several of these will be reproduced.

Of four Crookes tubes tried by Prof. Frost, but one emitted rays which (with the exposure given) made a visible impression upon a photographic plate protected from the ordinary luminous rays. This tube is one and three-quarters of an inch in diameter and is cylindrical for a length of six and one-half inches, then tapering to a point. The platinum electrodes are at opposite sides of the cylindrical surface and are two inches apart. In action the phosphorescent surface is bombarded from a discharge from the negative pole. The tube is usually excited by current from an efficient induction coil, though a Holtz machine has served about equally well. In taking the photograph of the hand which we reproduce, the tube was about three and one-half inches above the plate and the length of exposure was 15 minutes. The method was tested by Prof. Frost upon a broken arm, and after an exposure of 20 minutes, the plate on development showed a fracture in the ulna very distinctly. No effect except that of the usual metallic obstruction was noticed when the wire carrying the primary current was passed over the plate, or when the alternating current of the house circuit was sent through a loop of insulated wire resting on the plate holder.

In a letter to *Nature* of Jan. 23, Prof. Arthur Schuster says that Röntgen rays are not cathode rays, on which point there can be no doubt, but are generated at the point of impact between the cathode ray and a solid substance. He also says that there seems nothing impossible in the supposition that light-waves, smaller than those we know of, may traverse solids with the same velocity as in a vacuum. If Röntgen rays contain waves of very small length, the vibrations in the molecule which respond to them would seem to be of a different order of magnitude from those so far known. Prof. Schuster expressed a sense of satisfaction that Röntgen rays are not deflected in a magnetic field, as they are thus clearly separated from cathode rays. While the idea that cathode rays are due to vibration has become fashionable, the fact that the magnet deflects them just as it would electrified molecules has always seemed to him to be conclusive against this view.

In the same journal, Mr. J. T. Bottomley, a nephew of Lord Kelvin, quotes an extract from a lecture delivered by the latter at Johns Hopkins University in 1884. In this lecture Lord Kelvin said that while we ignore the compressibility of the ether in the theory of light, this is merely an assumption and one we have no right to make. We only know that any longitudinal vibrations which may be excited by the reflection or refraction of light are certainly of very small energy compared with the energy of the light from which they proceed. The question is always to be kept in mind for examination, are there or are there not very small amounts of condensational waves generated in reflection and refraction, and may, after all, the propagation of electric force be by these waves of condensation? An illustration is given to show that we can imagine a case whereby the action of electrical forces may create condensational waves, and he states that these would be propagated enormously faster than ordinary light waves. Another quotation from one of the Baltimore lectures is that the want of indication of condensational waves is sufficient to prove that if there are any in nature they must be exceedingly small. But Lord Kelvin believed that there are such waves and, furthermore, that the velocity of propagation of electrostatic forces is the unknown condensational velocity referred to.

Prof. Whiting, of Wellesley College, found that gum is the most transparent to Röntgen rays, and rock salt most opaque. At Guy's Hospital, in London, a sailor was admitted paralyzed in the upper and lower portions of his body; he had been picked up drunk from the streets, and an examination revealed nothing but a small wound in the back by the side of the vertebral column. Despite all treatment the man remained paralyzed, and after several days a shadowgraph was taken, which indicated the presence of a foreign body between the first dorsal vertebra and the first lumbar vertebra. An incision was made at this place and the blade of a knife taken out.

A Berlin cablegram states that a needle in the stomach has been detected at the Röntgen laboratory of the Reichsanstalt. A seamstress, who, some days before had swallowed a needle, was taken while in a critical condition to the laboratory and a Röntgen plate plainly showed every bone of the upper part of the body, the needle being found lying point downward in the lower right angle of

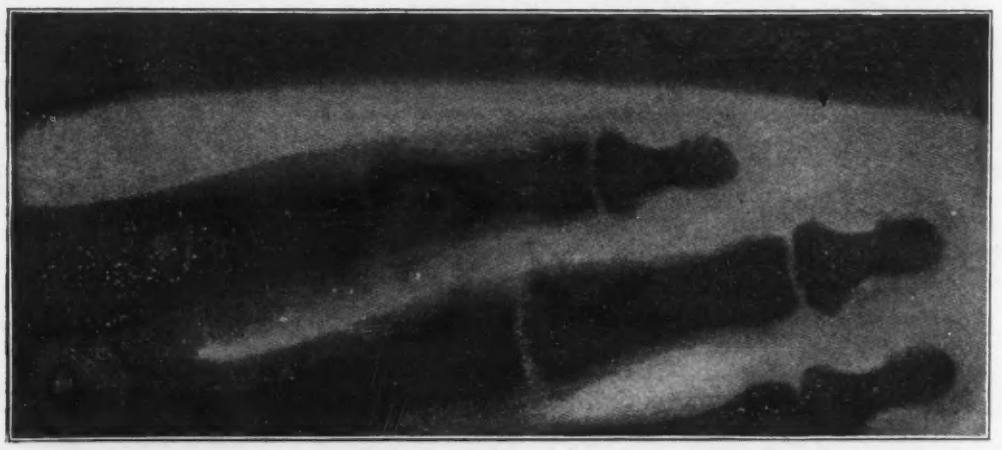


Fig. 4.—Shadowgraph from an Exposure of Fifteen Minutes.

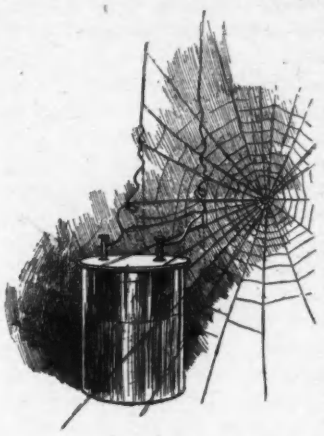
the stomach. The patient was placed under the influence of chloroform and the needle was taken from the stomach.

Prof. Wright, of Yale, states that he does not agree with Röntgen, that the rays outside the vacuum tube are not cathode rays at all, but a new form of radiation. He believes that the glass of the tube only acts by a straining process upon the rays as they pass through the tube, and that those outside are only changed in the respect that the glass intercepts a great deal of their effect.

Central-Station Working—IX.

CENTRAL STATION ECONOMY.

BY J. B. CAHOON.



IT is safe to assume that a greater portion of the central stations throughout the country are the result of misjudgment as to future needs at the time the original station was laid out, the expansion of electric lighting having far exceeded the anticipations of those who originally planned the stations. The result of such a condition of affairs is a station which is uneconomical to operate, but yet not bad enough to be condemned and rebuilt, and as the apparatus in these stations was installed when the cost was at least double what it is at the present time, it will be readily seen how difficult it is to make these stations pay a fair dividend on the original invested capital. It becomes a question, therefore, as to what steps can be taken to render this class of station more economical in its working and what additions can be made to it that will be profitable and help to make a fair rate of earning on the original capital.

I recall two of these stations which may be taken as being typical of the styles in vogue which belong to this uneconomical class, and are the result of an endeavor to meet the increased demand for lighting, but on which poor judgment, or poor engineering, or no engineering, was exercised in the purchase and laying out of the additions. The first station of which I speak is situated in a town of about 6000 inhabitants, and, as originally laid out, had one 50-light, 1200-cp arc machine, one 650-light alternator and one 20-kw power generator. These were laid out in a row, and at one end of the station was placed a 200-hp engine belted to a line shafting, from which the several machines were belted. This apparatus became overloaded in the course of two or three years, and an extension to the building was built, an addition made to the line-shafting, and a 400-hp engine placed on the other end of the line-shafting from the 200 hp.

Then soon came the necessity of putting on lights in the daytime in addition; the motor-power having all this time been operated continuously with the 200-hp engine, excepting Sundays, when it was shut down during the daytime for overhauling, repairs, etc. The increased night load was not sufficient to fully load the 400-hp engine as well as the 200-hp engine, and it was, therefore, even with the maximum run, uneconomical, especially the former, as it was compelled to drive the whole length of line-shafting, with the exception of about 20 feet on the other end, in order to drive the two arc machines, which were situated at almost the farthest point from the 400-hp engine. Similarly in their extensions of lines, they added on, without any regard to method or system, lines as the increased demand required, with the result that, at the present time, even in this small town, there are lines which are the next thing to a Chinese puzzle; but still they give a fair average voltage over the entire system, and hence, outside of the difficulty of tracing the lines when repairs are needed, the lack of system does not matter so much in this small town, but as the town and demand for lights increase so will the trouble with the lines increase until they will be compelled to rewire the town in a systematic manner.

Another company in a town of several times the size of the above was formed by the union of two old companies, when a new station was erected into which a portion of the old apparatus of each company was transferred, some of the alternating apparatus being remodeled to agree with the more modern type of apparatus. It is not necessary to go into details of the electrical apparatus, which is the same as is ordinarily found in most of the central stations, being arc and alternating machines, power-generator, etc., arranged for belting, however, to a line shaft. The great mistake which the designer of this station made was in his purchase and arrangement of the engines and line-shafting.

It is looked upon as good engineering judgment, even at the present time, to arrange a jack-shaft for belting a number of arc machines from, rather than arranging them to run two or more tandem off the fly-wheels of an engine, the object being to permit the shutting down of any one machine entirely; but when we go beyond this and extend a line shafting 136 feet, nearly the entire length of a station, as was done in this case, and space it so that large alternators cannot be advantageously belted off it, on account of the short distance between the centre of the shaft and the space where the alternators stand, and, at the same time, place the large engine for carrying the maximum load at the extreme end of the line shafting, so that to drive the arc machines with this big engine necessitates the entire line shafting being run, this would at least indicate that the designer was still living in the Dark Ages and following the old ruts.

A test of the horse-power actually taken to run this length of line-shafting, shows a loss in this way of 80 hp, and although other engines are spaced along the shafting with the idea of running portions of it to do certain work, inasmuch as the operation of the day circuit involves the furnishing of different kinds of light at various points, and it is necessary to run different types of machines, it is found that nearly the whole of the line-shafting must be run in the daytime and during the light load hours, and hence such a station cannot be operated economically without being entirely remodeled at quite a large expense. This will have to be done sooner or later if the station is to be operated to the satisfaction of the stockholders.

When the new station was built no attempt was made to remodel the lines other than to extend them from the new station to the nearest point touching old lines, and there is, therefore, a considerable difference in the voltage at different points of the lines. There still remains the old style of converter of 5 to 10 or more lights, according to the number of lights each customer is using. This naturally entails a large transformer loss and rapidly reduces the profits. In order to obtain satisfactory results the alternating lines will have to be entirely remodeled and divided into sections, each section being fed directly from the station. Where the bulk of the lighting comes, in the business portion of the city, secondary mains should be run and large transformers banked at the centre of each section, and arrangement made to cut in one after another of the large transformers as the load increases, and *vice versa*, at the same time running wires of sufficient size to prevent any material drop in the circuits. This station is not provided with recording wattmeters on its lines, so that it is a difficult matter to determine accurately the horse-power delivered to the line and to check up the loss in the lines and transformers.

Every line that goes out of the station, whether it be alternating current, power or arc circuit, should have a recording wattmeter on it so that at a certain time each day readings can be taken and the actual amount of power delivered to the lines ascertained, which, together with record of coal consumed, water, oil and waste, will enable the superintendent to determine accurately the cost per horse-power delivered to the lines, and, therefore, by checking back from customers' meter book, record of arc lamps, etc., he will be enabled to determine what portion of the energy of the station is going to waste, and ascertain clearly where the weak points of the system are, and at the same time strengthen these weak points.

There are many stations throughout the country which are not operating a day-lighting circuit that would find it to their advantage to do so if they could arrange to put in apparatus of proper size for this purpose and then make an active canvass of the town and secure customers for this circuit. We all know that the more load we can put on the station in the daytime, the nearer the station will approach to an economical point of working, the maximum being obtained when we get an equal load line extending over the 24 hours. As a rule we cannot obtain such a load line by the ordinary business of the station, but in many cases side issues can be taken up and added to the ordinary station work to a sufficient extent to bring up the day load line more nearly to that of the night load line, and it behooves every station manager to keep his eyes open for such chances. One station that I recall has materially increased its income and day load by furnishing steam heat to numerous business blocks within a moderate range of the station; another station has added an ice plant which it operates in the daytime, and the recent agitation in regard to the manufacture of calcic carbide for furnishing acetylene gas may possibly, if suitable furnaces can be obtained, afford a field for the station manager which may be just the thing that we have all been looking for to increase our day load.

A Warning to Wiremen.

Now that we possess the means of photographing the *unseen*, let the wiremen in future beware! By the aid of certain X-rays we can probe *his* joints and lay bare all their imperfections without disturbance to casings or coverings.—London *Electrical Review*.

On the Rays of Lenard and Röntgen.*

BY DR. OLIVER LODGE, F.R.S.

In the days of Gassiot and other early workers on the discharge in rarefied gas it was the stream from the anode that chiefly excited attention. It is this which displays the well-known gorgeous effects which used to be shown at nearly every scientific *conversazione*.

The discharge starts, indeed, from both terminals, but that from the cathode proceeds but a very little way, while that from the anode proceeds nearly the whole length of the tube, even though it may be many metres in length, traveling with something comparable to half the speed of light, as has been proved by J. J. Thomson

As exhaustions were improved the discharge was seen to change from a bright continuous streamer into a beaded or striated column, and it was the striæ upon which attention was then chiefly directed, as well as upon the outer or "second" dark space which had been so full of interest to Faraday. De la Rue, Spottiswoode and Moulton added to our knowledge of the occurrences in this stage.

The first, so far as I know, effectively to call attention to the surpassing interest of the events in the inner dark space, most closely surrounding the cathode, was Hittorf; but there can be no question that these dark-space phenomena were developed and expanded, and pressed home to the meanest apprehension most completely, by the highly skilful and brilliant experiments and exposition given to the Royal Society and the British Association in 1879 by William Crookes. Assisted by Mr. Gimingham, and working with vacua higher than anything previously attained, the discoverer of the radiometer irradiated the whole subject with a flood of light and set it on its present basis. The inner dark space was now broadened out so as to fill the whole tube; it was shown to consist of flying electrical particles, and everything exposed to their impact became brilliantly luminescent. Between Hittorf and Crookes must lie the discovery and the effectual vitalization of that now well-known phenomenon—the cathode ray. This constitutes the third stage in the development.

Then appeared Hertz; certainly one of the most marvelous combinations of mathematical and experimental power that we have seen in recent times. Not a word has been said in excess of the fame due to him; since Clerk Maxwell's death physical science has had no untimely loss like his to deplore. He found that the cathode rays impinging on German glass coated with gold leaf and other kinds of metal made the glass phosphoresce not only where it was uncovered, but, at sufficiently high exhaustion, also where it was covered with metal; discovered, in fact, that flakes of metal were more transparent to cathode rays than were flakes of mica of equal thickness.

Before and after his death his *quondam* assistant, Dr. Lenard, took the matter up, and with consummate experimental skill conducted a series of investigations that essentially started our till recently newest era. His ambition was to get the rays out of the vacuum into the open air, and at Hertz's suggestion he "glazed" his vacuum tube with an aluminum window for the purpose. Very thin, very small, and very delicate was Lenard's window, for it had to be thin enough to be cathodically transparent, thick enough not to leak air through imperceptible holes, and strong enough to resist the whole pressure of the atmosphere. The cementing of a metallic window on to a tube intended to be worked at such high exhaustion that an induction coil spark would prefer three cm of ordinary air rather than traverse the tube was no easy matter. However, the difficulties were overcome, the aluminum-closed vacuum tube was constructed, cathode rays of great strength were started inside it and directed onto the window, if necessary being deflected thereon by a magnet; and outside, in the otherwise perfectly dark region in free air, on the other side the partition, the air itself, as well as the window, were seen to be glowing with a faint phosphorescent light. Strongly fluorescent materials held in this region were, of course, brilliantly lighted up; and photographic plates and films were quickly blackened. The rays from the window were not a mere prolongation of the cathode stream; they started afresh in all directions, as light does when a parallel beam impinges on a minute orifice. The skin and the eye could feel nothing of these rays, but fluorescent and photographic materials were abundantly sensitive. Lenard conceived that he had here a novel kind of ethereal radiation; but whether it consisted of very minute transverse waves, analogous to light but much higher up in the spectrum than those usually called ultra-violet, or whether it consisted of waves not transverse, or of something else not waves at all, he did not pretend to decide. Certainly material bodies introduced into the rays behaved in a very different manner from the way they behaved to light. Dense bodies were rather opaque, rare bodies were rather transparent: and nothing to do with electric conductivity seemed effective in connection with these rays as it was with light—nothing but density seemed much to matter. Hence, certainly they were not Hertz waves or anything submissive to Maxwell's equations—conductors must be opaque to *them;* unless, indeed, the molecules or their interstices could be dealt with, instead of coarse groups of them, in which case ordinary conductivity ceases to exist, and abnormal transparency can be fairly explained. Hydrogen was found to be the most transparent of the gases by Lenard, but if it were squeezed till it was as dense as oxygen, then it behaved just like oxygen, and so on. Metals and non-metals of equal density were about equally opaque, roughly speaking. Moreover, nothing was dead opaque or clearly transparent; all substances were turbid, like milk. They did not stop the rays by reflection, but by diffusion. After going through a sufficient thickness of matter, the beam, limited and made definite by a suitable diaphragm, became fuzzy and bordered by a sort of aureole when received on a fluorescent screen. But this turbidity, he is careful to say, is not increased by dust or suspended gross matter. It is a true *molecular* turbidity, and indicates that he is dealing with something of molecular magnitude.

Aluminum was more transparent to these rays than quartz, *and a shadow photograph was taken to illustrate this, by putting a sensitive plate in an aluminum-fronted box*, and then interposing in the path of the rays, between the source and the sensitive plate, a couple of rectangular strips of quartz and aluminum, partially overlapping. The plate, on development, showed four regions; the darkest when it had not been screened at all, except by the walls of its perfectly light-tight box, the next darkest where the shadow of the aluminum rectangle had fallen, lighter still in the shadow of the quartz strip, and almost unaffected in the portion screened by the two overlapping materials. All this, it must be noted, in 1893 and 1894.

One more observation I give in his own words: "On replacing the aluminum window by one of glass it was found possible to repeat all the essential experiments with equal success. But the aluminum window remains the more suitable; not that it is more transparent, but because aluminum is opaque to light and more easily manipulated than glass of equal thickness."

Thus Lenard had actually got the rays to come out of a plain glass vacuum tube, provided it was highly enough exhausted and with thin enough walls.

The writer well remembers trying, in 1894, to get the Lenard rays out of a not unsuitable but rather thick vacuum tube, in stupid ignorance of this just-quoted result, and failing. Failing simply by reason of insufficient pertinacity, as it now turns out, for this very tube is by him now, and with it he has been able, aided always by his admirable assistant, E. E. Robinson, to repeat Röntgen's results and get good photographs without trouble through a quarter inch of wood and a sheet of aluminum, provided something like a half an hour's exposure is allowed. The tube is a large one, without electrodes, and to excite its fluorescence the coil should be provided with knobs, which are allowed to spark directly into each other; the tinfoil coatings on the glass then act as Leyden jars, and give impulsive rushes into the tube.

Lenard tried whether the rays would charge a body electrostatically, but they would not. On the contrary, they rapidly discharged a body already charged, and this equally, whether that initial charge were positive or negative. This experiment probably influenced him to conceive of his rays as something ethereal, and to deny that they were streams of electrified particles bombarded off his window by the impact of the cathode stream. He considers that the passage through metal has effectually filtered all the truly *electric* properties from his rays; and, accordingly, he is prepared to find, as he does, that they neither decompose nor liberate gases from anything, as the unfiltered cathode rays themselves do. True, the filtered rays, which it is now convenient—at least, for the present—to style Lenard rays, are able to precipitate chemical actions in sensitive silver gelatine films; but when it is remembered how surpassingly responsive these are to a luminous stimulus, it may well be conjectured that the Lenard rays act only in a physical and secondary manner by the intervention of some kind of phosphorescence (a term much better replaced by "*luminescence*," in accordance with the suggestion of E. Wiedemann, whenever there is nothing of the nature of phosphoric combustion).

Getting the rays into exhausted tubes he finds them traveling several metres in a straight line, and keeping clear and sharp, provided

* From the London *Electrician*, Jan. 31, 1896.

the tube is sufficiently exhausted, the last traces of mercury vapor being, in this instance, lessened by application of a freezing mixture after days of pumping. In such a tube no cathode rays could have been *generated*, but the Lenard rays are just in their element. Must it not be then, he asks, that this element is really the ether?

Now comes the crucial experiment: Are the Lenard rays deflected by a magnet? Experiment answers they are. When the medium is turbid and produces an aureole the experiment is not distinct, hence Lenard did not succeed in either proving or disproving deflection in common air, but in a "complete" vacuum the deflection is clear and sharp; in a partial one, when there is a little aureole, the hazy patch is deflected more than the central spot, and is, in fact, spread out into a kind of "magnetic spectrum."

Varying the pressure of the gas causes no alteration in the deflection of the central spot, it only affects the position of the deflected aureole or diffusion caused by the presence of gross matter; the clear central, unaltered spot, he argues, must be something ethereal. How, then, can it be deflected by a magnet? Light waves are not thus acted on. By no direct force he conceives the answer to be: by a modification of the ether, caused by the magnet, a modification which twists the ray aside somewhat after the fashion of Faraday's rotated plane of polarization; and in proof of this he adduces an experiment of Hertz to show that there is no reciprocal force acting on the magnet, in other words, that the ray is not *forced* aside, like matter, but skewed aside by an ethereal twist.

The theoretical views of an experimenter are not to be lightly scorned, even when they fail to accord with our well-based prepossessions. A man who lives among phenomena is to be listened to, for he often feels instinctively more than he can logically establish and justify. In this country, however, with all due respect to the illustrious experimenter, his theoretical views have not found favor. The writer, as well as other more competent judges, have felt, and consistently expressed the conviction, that the fact of magnetic deflection pointed to a stream of electrified particles; it might be to a kind of Grotthüs chain, or electrolytic radiation, but at any rate to something material, not ethereal. Arguments based on occurrences which go on in the presumed absence of matter, say in tubes exhausted to the hundred millionth of an atmosphere, are very weak, because every cubic millimetre of such "exhausted" space still contains a hundred thousand million fully-fledged molecules. The marvel is that phenomena in space so crowded with substance can yet be so strikingly different from those which occur when the matter is made, say, a million-fold denser. Nothing, therefore, seemed conclusive *against* the radiant-matter idea, and the fact of magnetic deflection seemed almost conclusive in its favor.

Once more let us ignore theoretical views at present and stick to facts. Lenard found that although varying the gas in his *observing* space left the main magnetic deflection unaltered, so long as it could be clearly observed, yet that a variation in the exhaustion of the *originating* space, where the undeniable cathode rays were impinging on his window, produced a notable effect. An increase in the exhaustion of this vessel was found to decrease the deflecting power of a given magnetic field on the Lenard rays outside. Hence, if the exhaustion could be pushed to extremes it may be urged as probable that the magnetic deflection would almost cease.

(A remark must be interpolated here to the effect that the last-quoted fact lends strength to the idea of electrolytic radiation, or at least of radiant matter in some form, as opposed to an ethereal process.

For conceive an atom of mass m charged with the quantity q flying with velocity v through a magnetic field of intensity H. It is equivalent to a current $q\ v$, and it experiences a deflecting force $q\ v\ H$. Hence its acceleration is $\frac{q\ vH}{m}$; and, since this is normal to the velocity, it can be equated to the usual centripetal acceleration $\frac{v^2}{r}$, where r is the radius of curvatures of the orbit or trajectory of the particle.

Wherefore it follows that the magnetic curvature of the path is

$$\frac{1}{r} = \frac{q}{m} \cdot \frac{H}{v}.$$

The first factor is the reciprocal of the ordinary electro-chemical equivalent of the substance, and is known; hence the curvature is expressed in direct proportion to the reciprocal of the velocity. A lessened curvature, therefore, simply points to a higher velocity, and at sufficiently high exhaustions it may happen that a few of the molecules in the vacuum tube, under the stress of the potential gradient on their enormous charges, are moving with something approaching the speed of light. Most of them are much slower, as J. J. Thomson has indicated, but it is permissible to think of some as having excessive speed. If so, the path of such particles would be probably straight through any ordinary magnetic field such as has hitherto been applied to test them. And on the usual impact principles, of receiving and handing on motion, atoms driven away by them from the other side of a partition might be expected to receive and pass on something like this enormous speed for some distance further.)

Lenard found that there were different kinds of his rays: some of them more deflectible, some of them less; those which are more deflectible are more affected by turbidity, and soon get stopped by moderately opaque substances, but those which are less deflectible are more pertinacious in their passage through matter, and may be expected to penetrate to considerable distances; even through reasonably opaque media.

Can it be possible, the writer now goes on to ask, that Prof. Röntgen has utilized these very rays? It is evident that the apparatus at his disposal is pre-eminently adapted to exhibit Röntgen radiation, whatever it is. No other experimenter seems to have obtained such good results, unless there are some not yet widely published. Mr. Swinton, by application of immense power, has come nearest to it in this country so far, but the rays used by him do not appear to penetrate the flesh of the hand with anything like the ease that Prof. Röntgen's do. Those used by me at present are also less penetrating. They give good results with metals, but with the hand the bones hardly show through the surrounding material (the finger nails come out clearly transparent). Lenard, it appears, used something of this last sort of radiation, and matter appeared to him more turbid than it does to Prof. Röntgen. Why is Röntgen's source of rays so powerful? Is it the kind of glass, or its size or its exhaustion, or has it something to do with the electrode? He has not yet told us the details, but it may be surmised that his Crookes tube happened to be extra well exhausted and of good German glass (English glass seems useless). At any rate, he seems to get easily what others get with difficulty. Certainly he is most warmly to be congratulated!

Once more, considering the question of the possible hypotheses, Prof. Röntgen leans to the view that they may be longitudinal ether waves. Authorities in this country are hovering between ultra ultra-violet waves, on the one hand, and longitudinal vibration on the other.

The writer only hopes that it *may* turn out a longitudinal vibration. There is a great deal to be said in favor of such a view and, on the whole, it seems to the writer the most probable of the ethereal hypotheses; more probable than that of extra ultra-violet light, because of the transparency of the metals. The fact that simple material *density* is the chief factor determining opacity, has a very gravitational look about it. Can it be that at last we are in the track of gravitation experimentally? Anyhow, if it be but something periodic comparable to the size of atoms, many problems of supreme interest would be in a fair way of yielding up their answers. The writer hopes at least that it may turn out something ethereal, and may give a method for determining μ and K; but for the present he permits himself to doubt, and inclines to a sort of electrolytic impulsive propagation through and by means of ordinary matter, in spite of the immensely important fact that Prof. Röntgen can detect in his rays no magnetic deflectibility whatever. The clearness of his rays enables him to achieve this result in ordinary air. It is to be remembered that Lenard was only able to observe his deflections in a partial vacuum. Ordinary air was too turbid, and the image too indistinct. This experiment of no magnetic deflection of the Röntgen rays I have, indeed, so far confirmed as to be satisfied that any deflection there may be is extremely small—far smaller than that appropriate to any kind of known cathode rays. Perhaps it is *nil*, and if so, projection of charged particles is *ipso facto* and finally put out of court; but perhaps it is only small, in which case, as has been shown above, charged particles flying at high velocity are indicated. It would only be the most rapid particles that could get through the obstacles and imprint themselves upon the plate, and it is just these that would be least deflected. Hence, until the details of Prof. Röntgen's magnetic experiments are forthcoming, there is still a loophole for the dullest and most commonplace of all the at present conjectured explanations. Meanwhile, the possibility, even the probability, that in these rays we have a new kind of radiation, even though it be only ultra-violet so high up as to be comparable to the size of molecules, lends to these experiments a prodigious interest in the eyes of physicists, far surpassing the obvious practical applications which have gained the ear of the general public.

A Modern Alternating-Current Station.

Descriptions of electric lighting stations usually have a sameness about them, often containing nothing of interest to the engineer. The new station of the United Electric Light & Power Company, in New York City, however, is a exception in this respect.

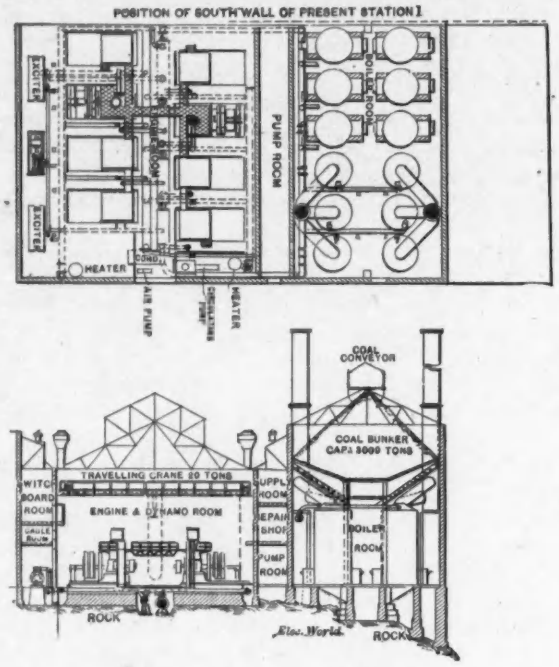


FIG. 1.—PLAN OF STATION.

The station is located between East Twenty-eighth and Twenty-ninth Streets and close to the water front, which is owned by the company. It was designed for 20,000 horse-power, and will ultimately cover the entire block. At present its capacity is 5000 horse-power, and with this it can take all the load of its district, with the exception of that carried by the old plant on Twenty-ninth Street. The area covered is from the Battery to Fifty-ninth Street.

The ground dimensions of the completed station are 160 feet 11 inches by 197 feet 6 inches, and on this limited area the entire 20,000 horse-power, steam, mechanical and electrical, is to be installed, all being on the ground floor. The building is an iron-frame structure with brick inwalls, and has a bed-rock foundation. These foundations were the cause of considerable trouble and calculation. In excavating a rock was found that was apparently very substantial, but it was discovered afterward to be so thoroughly interspersed

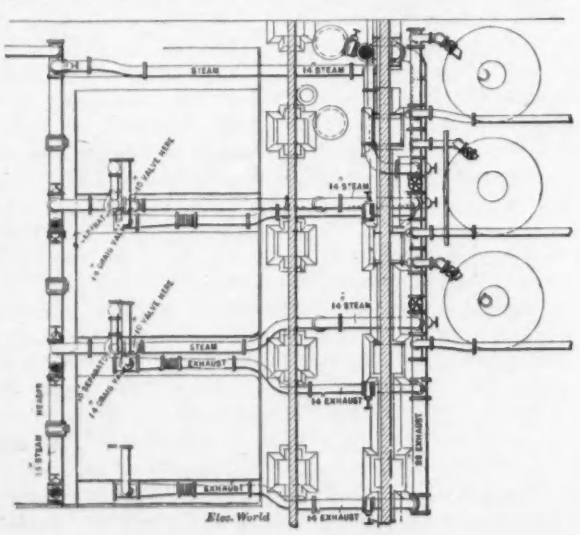


FIG. 2.—PLAN OF PIPING.

with small particles of mica and matter of a silaceous nature that it was impossible to use it as a foundation. Large quantities, therefore, had to be removed, except in the few cases where the deposit showed substantial qualities in a sufficient measure to warrant building the foundation directly upon it.

The enclosure of the building is of brick, except a temporary wall of corrugated iron between the old and the new stations. This brick inwall is double, having an air space of two inches intervening between the two walls, which are 8 and 15 inches respectively. This proves a most efficient sound deadener, and standing on the sidewalk it is impossible to tell whether the machinery is in motion or not. The windows are all double. The roof is lightly built and only calculated to stand the weight of snow and wind pressure. The 36-ton crane runs on trams supported by separate columns, 75 feet apart.

A general plan of the station is shown in Fig. 1. The boiler room plan is also shown in Fig. 1. A plant of six Climax boilers supply steam at a pressure of 150 pounds. These boilers are of 600 horse-power each, and have 588 tubes. Twelve boilers is the ultimate equipment.

The boilers receive their coal from a bunker directly over them, which is filled by a traveling conveyor. At present this conveyor takes coal from carts which dump it into chutes in the sidewalk, but in the near future it is intended to arrange the conveyor so as to take coal directly from the barges at the water front, thus saving the trouble and expense of teaming. The capacity of the bunker is 3000 tons, and when the station is completed the total coal capacity of the bunkers will be 6000 tons. The weight of the coal is carried on a V-shaped bottom so arranged that every pound of coal will be spouted to the boiler room. The distribution of the supporting beams is in direct proportion to the weight, the beams being nearer together at the base of the V. The coal needs no trimming or hand shoveling while emptying or filling. Suitable spouts deliver the coal as required on the boiler room floor.

The boilers are shown in process of erection in Fig. 5. The boilers deliver their waste gases through smoke tubes to two steel smoke pipes, one pipe serving three boilers. The smoke pipes are 127 feet above the grates. The holes in the pipe to receive the smoke tubes are elliptical instead of circular, so as to weaken the pipe as little as possible. An air space is provided around the smoke pipe, both as a heat insulator and a means of ventilation, and a steel umbrella prevents rain and snow from entering the top.

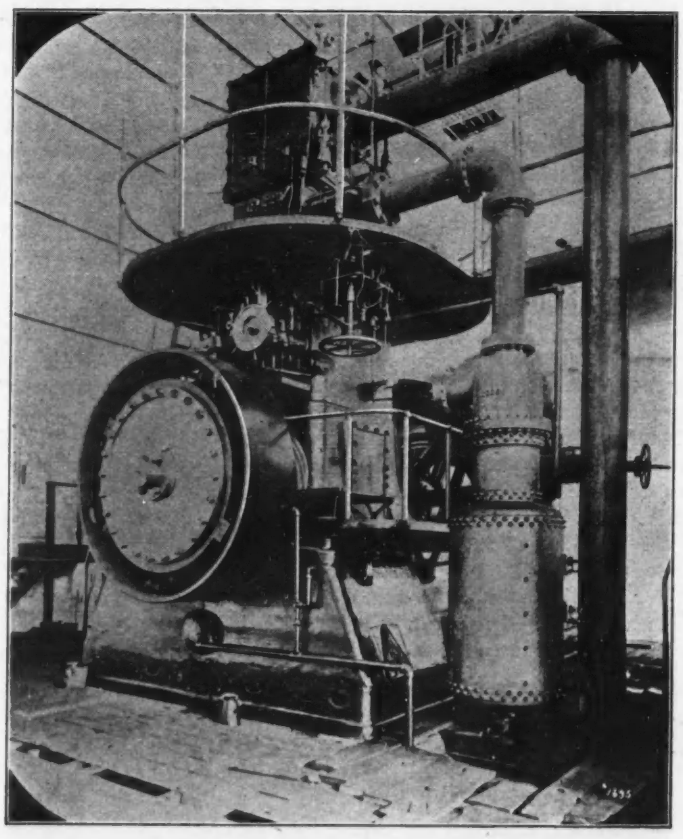


FIG. 3.—ONE OF THE UNITS.

Steam is drawn from the boilers by a loop system of piping, the invention of Mr. H. W. York, the chief engineer. The boilers deliver their steam to a long header, and parallel to this header and at a distance from it is another header connected thereto by mains from which the engines draw their steam. Thus the steam mains are fed from either or both ends and the pipe would have to burst in

two places to disable the engine. Valves are so interspersed in the system as to render it possible to readily cut out any disabled section of piping. This method accomplishes the advantages of a duplicate system of piping without the attendant expense.

A good idea of the arrangement may be had by consulting Fig. 2. This principle of feeding a main from both ends is utilized throughout the system of piping and every important pipe is so arranged. The same method has also been extended to the feed-water

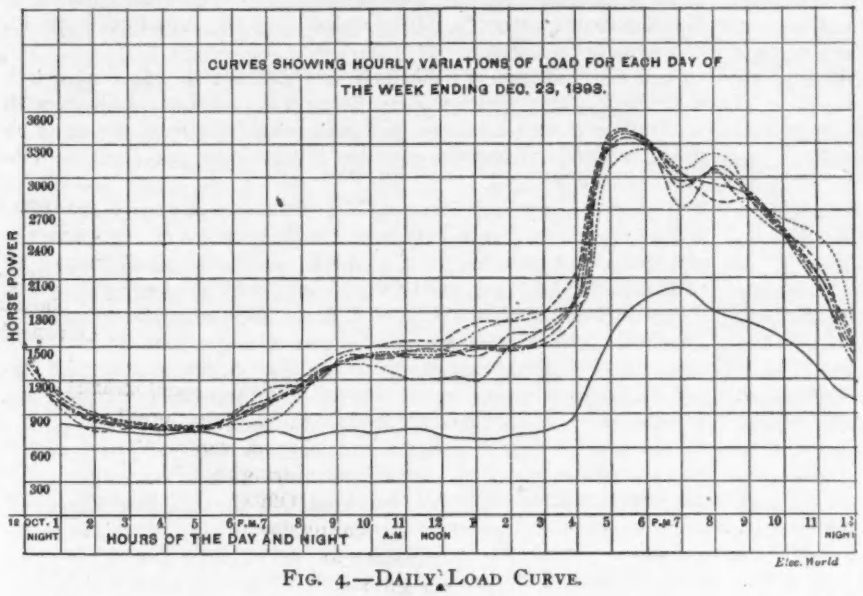


FIG. 4.—DAILY LOAD CURVE.

piping on the boilers. The piping is so arranged as to avoid expansion joints. The pump room occupies a space between the boiler and engine rooms and shields the latter from the dust of the former. A long header receives the condensation from the steam system. In this division of the station the spindles of the valves pass through the boiler room wall so as to enable steam to be shut off at the boilers in case of accident without entering the boiler room.

The steam received by four 1200-hp Westinghouse steeple top engines, direct-connected to the alternate-current generators. Before entering the engines the steam passes through a large receptacle which serves the double purpose of separator and receiver. This separator, which is shown in Fig. 3, will contain 18 charges of steam. The sudden motion of cutting off steam in a large main produces a very heavy jar unless some cushioning device of this nature

FIG. 5.—BOILERS IN PROCESS OF ERECTION.

is employed. In this case vibration from this source is hardly noticeable. The large separator and the loop system combine to admit of using smaller pipes. The largest steam main is but 16 inches. A view of a single steam unit is shown in Fig. 6. They are mounted on a bed-rock foundation and no cushioning device whatever is employed. The base of the engine is secured to the foundation by long bolts passing through the sub-base.

The rigid foundation has been found to give better satisfaction than cushioning devices at first suggested. All the foundations rest on a concrete floor 14 feet below the engine room floor, except the exciter foundations, which are on the natural rock. In the case of these machines, the rock was found to have more favorable grain and to be of a firmer nature and could, therefore, be utilized. The exciters are small 100-hp railway generators, with a simple 10 by 12 Westinghouse engine directly connected therewith. Their speed is 300 revolutions per minute.

The condenser capacity of the station is sufficient for only one engine. The reason for so equipping the station was found in the daily load curve, which is shown in Fig. 4. The seven curves represent the load for one week, each curve representing a different day. The lower curve was taken on Sunday. The peak of the load is but six hours long, and at all other times one unit can take care of the load. Therefore, for a few hours, the running of an engine non-condensing would not be such a serious matter of economy, and hence but one condenser was installed, which operates all the time. During the short time that it is necessary to run an extra unit in connection with the one carrying the regular load, this unit is allowed to exhaust into the atmosphere after passing through a 4000-hp heater. The generators have a frequency of 7200, and deliver current at a pressure of 2500 volts. There are 36 poles in the field magnet, and the speed of the armature is 200 revolutions per minute.

The station, while not architecturally beautiful, is a most substantial structure, and the compact arrangement of the great power which will be its ultimate capacity cannot fail to excite interest and admiration. Station designers desiring to install new plants would do well to carefully study the numerous original methods that are embodied in this installation.

Röntgen's Rays at the Philadelphia Photographic Society.

At the meeting of the Philadelphia Photographic Society held on the 12th inst. the theory and utilization of Röntgen rays was the subject of discussion. Shadowgraphs and lantern slides were exhibited of such objects as the human hand, a diamond scarf pin, a pin cushion full of pins, purses of coins, etc., which were made by Mr. John Carbutt, Mr. Jennings and Dr. Goodspeed, of the University of Pennsylvania. The objects shown resembled those already illustrated in this journal and the public press, but were, however, well exposed and developed, showing with great distinction the lines of flesh and bone, diamond and gold, etc. Mr. Carbutt stated that he has succeeded in producing a plate especially sensitive to the Röntgen rays and by a method which enabled him to reduce the time of exposure required from one half to two thirds the time necessary for the most sensitive ordinary plate. He showed several excellent negatives made by himself, the exposure in one case being 21 minutes, and in another 30 minutes, whereas in nearly all the exposures yet recorded the time has been one hour or more. The Crookes tube in action was shown and explained, and a shadowgraph made in the presence of the society. The time of exposure was 20 minutes, the plate being enclosed in a pasteboard box, on the lid of which were laid several objects, the whole being placed directly under and a short distance from the vacuum tube. The full development requires about an hour, but it was not carried to that extent in this instance, though the outline of the objects was plainly discernible after a short treatment.

It was suggested that the fogging of plates which have never been exposed to ordinary light, which has been frequently observed, might be due to their having been subjected to the action of similar rays to those of Röntgen emanating from the electric light or other source. A simple experiment will, of course, determine the fact. Plates are quickly fogged on exposure to the Röntgen rays. The importance of the discovery to surgery and metallurgy was dwelt upon by several members, and one eminent physician remarked that even with our present limited knowledge of this new discovery it would now hardly be admissible to probe for extraneous matter in the human body without the aid of this method. All the Crookes tubes in Philadelphia for sale have been purchased, which certainly illustrates the universal interest in these new and important phenomena.

National Aid to Engineering Schools.

A bill now before Congress, introduced into the Senate by Senator Squire, of Washington, and into the House by Representative Wilson, of New York, includes among its provisions some important educational features applying to scientific and technological schools and colleges. These provisions provide for the establishment of a course of instruction in naval engineering in the several scientific and technological schools of the United States, and the endowment and support of such courses of instruction, as well as the strengthening of the present engineering courses of all such institutions, to the end that they may become fitted to meet the educational requirements of the naval engineering service. The engineering departments not only of State but of other colleges and universities are to be included in the benefits.

To aid these several schools in establishing and maintaining a "course of instruction in mechanical engineering," which shall be satisfactory to the national government, the bill provides that all such institutions becoming beneficiaries of this federal aid may obtain by loan or gift from the government such models, plans and machinery as can be spared without detriment to the naval service; they shall receive all professional and naval literature in the form of monographs and similar publications issued by the Navy Department, all of which shall be furnished free of cost to all students who pursue the accredited course; professors of naval engineering will be assigned by the government to give practical and theoretical instruction in the departments of knowledge concerned in the branch of naval engineering; efficient and thorough supervision of such instruction to be under an inspector-general of naval engineering. The bills also open appointments to the Engineer Corps of the United States Navy and to the engineering graduates from the institutions which become beneficiaries under its provisions.

This is one of the most comprehensive measures for the promotion of engineering education and the consequent industrial development to the several States that has yet been presented. If it becomes a law it will rank in importance with the Land Grant Act of 1862, and the Morrill Bill of 1890, but will bestow its benefits upon a greater number of scientific schools, colleges and universities than contemplated or provided for by either of the former bills. While its provisions have in view more particularly the requirements of naval engineering, yet the additions to the laboratories which will follow from its provisions will materially strengthen the entire engineering department of the schools; the engineer officer to be detailed as professor will be a valuable addition to the mechanical engineering staff of the faculty, and graduates will have opened to them a desirable branch of the government service.

The Interior Department and the Telephone.

BY E. F. FROST.

Under date of Aug. 25, 1894, the Department of the Interior, under which is included the Patent Office, issued proposal forms with specifications for "Extending and Enlarging" its "Telephone Exchange System."

This specification among other necessaries called for telephone sets which were each to consist of a transmitter, receiver, battery, magneto-generator and bell complete. The transmitter specification reads as follows:

"The transmitter is to be a carbon transmitter of approved pattern and must be demonstrated to have an efficiency at least equal to that of the ordinary Blake transmitter." "The transmitters are to be mounted on desk stands, with switch and holder for receiver, etc."

Under the general conditions is the following:

"The contract will contain a warranty, on the part of the contractor, that the said telephone system, apparatus and appliances, or any part thereof, shall not infringe any patent of which he is not the patentee or assignee; also a covenant that he will well and truly save, keep and bear harmless, and fully indemnify the United States from and for all damages, or claims for damages, in law or equity, that may at any time arise or be set up, for any actual infringement of the patent right of any person or persons in consequence of the use by the Department of the Interior or any of its officers or agents, of the article or articles contracted for and furnished by him."

It was shown the Department of the Interior that under such requirements there could really be but one bidder—the American Bell Telephone Company—and as a result of the opening of such bids as were made a new specification for proposals was drawn which appeared under date of Nov. 10, 1894.

In this specification the following was a requirement:

"Telephone sets are to consist each of a transmitter, receiver, and bell, with battery and magneto-generator, if required, in the system adopted. The instruments are to be mounted on desk stands in every case, with switch and holder for the receiver complete, etc. It is not intended to limit the proposals to either microphones or magneto-transmitters." The guaranty was the same in this specification as in the former.

As a result of tests of exhibits it was decided to adopt a certain magneto system, the transmitter being a magneto-transmitter, with the further result that these were replaced almost from the start by granular carbon transmitters, which in turn have given considerable trouble from packing.

Under the first specification it would seem strange that the Interior Department could have been totally ignorant of the existence of the Berliner patent, which, if valid, would necessarily make all carbon microphone transmitters infringing; for this very patent was issued by its bureau, the Patent Office. Even though secured by guaranty against loss from infringement suits is it the policy of the Interior Department to invite suit? Of course, the department can take the ground that it is not a judicial power and has merely to secure itself against judicial proceedings.

The same might be said with reference to the Watson switch patent. As a result of the substitution of the microphonic for the magneto-transmitters, one may ask if the magneto guaranty was modified so as to cover the departmental use of the micro phone.

In the meantime, the American Bell Telephone Company, one of the competitors under the specifications, has been perfectly aware of all that has taken place, but as yet has taken no action in the matter, even though it owns both the Berliner and Watson patents.

Notes on Accumulator Testing—II.*

BY CARL HERING.

Unless, as is seldom the case, the accumulator is to be used in practice at only one specific rate, it is very important to make a number of tests at different rates. The manufacturer will find this very necessary, as it will show him not only for what rate his accumulator is best adapted, but it will also give him the necessary data for calculating the number and size of the cells required for a specific plant; besides this, the results may indicate to him how and in what directions his plates might be improved. The consulting engineer who is testing a cell for a prospective purchaser will find it very necessary to make discharges at different rates, for unless he does he cannot form a correct opinion as to its limitations, merits, or defects.

What rates to choose depend on what the accumulator is intended for, but if this is not yet known, then a few discharges at different rates will soon show for what purpose the cell is suited or unsuited. In general, a 10-hour rate may be considered as a slow rate, and it will rarely be necessary to make a test at a slower one; the tests become very tedious when longer than 10 hours; a test at a very slow rate may sometimes be of interest to the manufacturer to show him what the maximum capacity is. About 5 hours may in general be considered as a fair normal rate and from, say, 3 hours to ½ or ¼ hour a rapid rate.

As was said above, the useful capacity of the usual type of accumulator depends very greatly on the rate, and therefore a mere statement of the capacity is insufficient; it should always be accompanied by the corresponding rate, preferably in hours. Having made a number of tests at various discharges, the results may be plotted and a curve drawn, from which the capacities at other intermediate rates may be measured. For such a curve the ampere-hours or watt-hours may be made the ordinates, and the rate in hours or minutes the abscissas; such a curve will resemble in general outline the shape of a magnetization curve, except that it tends to become horizontal. For a theoretically perfect accumulator this curve ought to be a horizontal line, which means that the capacity should be independent of the rate, but in practice it is always curved at the left-hand end which represents exceedingly rapid discharges, though for a good rapid-rate accumulator the rest of the curve ought to be nearly horizontal.

* Continued from THE ELECTRICAL WORLD, Jan. 4, 1896, p. 10.

For a certain rapid-rate accumulator the writer found* that by making the ordinates watt-hours and the abscissas watts, the curve, for the working range, was a straight line, which started at a certain value on the Y axis (representing the theoretical maximum capacity), and then descended downward slightly. This is a relation which is very useful in practice, as it enables one to calculate readily what the capacity will be for any desired power. This straight-line relation simply means that the capacity in watt-hours (for that cell) is equal numerically to a constant maximum, less a certain fractional part of the power in watts at which it is discharging. Theoretically it ought to be a horizontal line, if the internal resistance is zero. A similar straight-line relation exists between the ampere-hours and the amperes. It does not follow, however, that this is necessarily such a simple relation for all types of accumulators, but it may be said that the nearer it is approached the more perfect is the accumulator, as far as it relates to the dependence of the capacity on the rate.

While it is very easy, of course, to make a cell discharge at a certain current, or even at a certain power, yet it is difficult and tedious to make it discharge during a certain predetermined time, that is, at a certain predetermined rate in hours, assuming, of course, that either the current or the watts are kept constant. It can be done only by trial discharges which may become very tedious, as they may be very numerous until the proper one is found. This arises from the very important fact, which cannot be impressed too strongly upon those making accumulator tests, that no discharge can be considered reliable unless it was preceded by a similar one under exactly the same conditions, which gave the same results. If the results of two like discharges (the charges being, of course, also the same) are not alike or nearly so, then it shows that the cell has not yet recovered from the effects of preceding charges and discharges at rates which were different from the present one, and the test must then be repeated until two succeeding discharges under exactly the same conditions give practically the same results.

If, for instance, a rapid discharge is followed by a slower one, the capacity for the second one will be greater than the true amount, and the efficiency may even exceed 100 per cent., or at least be very high, which would not represent the truth. If a slow discharge is followed by a rapid one, the reverse will be found. Popularly speaking, a slow discharge may be said to empty an accumulator more completely, while a rapid discharge always leaves some of the previous charge in it, and this remainder will then make its appearance in the next slow discharge. In general, the capacity will be greater the slower the rate of charging, even though the discharging rates are high.

Instead of trying to make a cell discharge itself in a certain fixed time, it is simpler to make the rate as nearly equal to the desired one as convenient, then discharge at higher and lower rates (always repeating the discharges as above described until two subsequent ones are alike) and plot the results, drawing a curve through the points obtained; the discharge at any definite rate in hours can then be obtained from this curve or by arithmetical interpolation.

The possible destructive action of rapid rates must be determined by inspection; it may require a number of such discharges to definitely determine the injurious effects.

Besides giving the rate in hours it should also be stated in amperes per pound and watts per pound of cell complete in order to give data for making estimates for portable plants, and to enable the results to be compared with those obtained from other cells.

Before beginning the tests it is very important to decide on what shall be considered the ends of the charge and the discharge, as very much depends on this. If charged too long the subsequent output may be greater, but the efficiency will be lower and the plates may be injured by the gassing. If charged too little the capacity is less but the efficiency better. If discharged too far the capacity is greater, the efficiency less, the variations in voltage much greater, and the destructive action on the plates, as a rule, increased. If the discharge is stopped too soon the capacity is less, but the efficiency is better. The destructive action on the plates, of course, determines the extreme limits which should not be exceeded, but inside of these limits the stopping points for the charge and discharge depend on whether a high efficiency or a high capacity are desired. If any comparisons are to be made between different rates for the same cell, some fixed rule regarding the stopping points must be adopted and adhered to, otherwise the comparison is not a correct one.

The best way to find the proper stopping points is to make a preliminary test, then lay off the curve of the voltage and find the points where it begins to rise rapidly for the charge and fall rapidly for the discharge; these may then be adopted for subsequent tests, provided they do not exceed the limits at which destructive action begins; probably in but few, if any, types of cells will the former limits exceed the latter.

To state this limit in the form of definite final voltages, or a definite increase or decrease in volts, is not strictly correct; at least, not when making comparisons at different rates; it is more rational to state it as a certain percentage rise or fall of voltage, taking as the initial voltage that at the terminals while charging or discharging, soon after the start, and not that on open circuit or immediately at the start. A short time after the start the voltage will be found to remain nearly constant, and this is the best one to use as the initial voltage; a certain percentage of this, determined as above described, by a preliminary test, may then be taken for the allowable rise or fall, respectively, to determine the end of the charge and discharge. This same percentage may be used equally well for rapid and for slow discharges. It is, of course, not necessarily the same for the charge as for the discharge.

Even though the accumulators may in practice be discharged discontinuously, yet, for testing, some uniform system must be adopted, in order that fair comparisons may be made between different cells, or between the same cell at different rates. In such tests the charge and discharge should therefore be made continuous, and not intermittent, not even in only two parts, with a period of rest between them.

The most rational way to charge is at constant voltage, which means a large current at the start, diminishing to a small one at the end. But to attempt to keep the charging voltage constant during a test will be found to be useless, as the current may be varied within wide limits, without any appreciable effect on the voltage. The best way is to approximate this by starting with a large current and keeping it constant for a short time, say until the voltage shows signs of rising appreciably, then reduce the current suddenly to a lower value (taking a reading of the voltage for both currents for the same time reading), then after a while to a still lower one, and so on, until at the end of the charge the current is small. This is more tedious than to charge at a constant current, but it is thought to be better, and a little experience will soon enable one to make a proper choice of the currents. If these charges are made in steps of less than one hour, it is best to compute the capacities for each step in ampere- and watt-minutes, instead of hours, making the reduction to ampere- and watt-hours once for all for the final total result, instead of for every step.

Discharges are best made at a constant current, as that more nearly represents the average practical conditions. The current should in that case be kept constant by means of a rheostat, which can be altered by very small increments. A carbon resistance, made of a horizontal row of plates, compressed by means of a screw, will be found to be very convenient. The next best way is to discharge through a constant resistance, and therefore with a decreasing current, but the calculations are then more tedious, and the watt-hours may have to be calculated for each reading, instead of once for all, as in the previous method. If the cells are to be used for power purposes, as for traction, for instance, it would be more correct to discharge at constant watts, instead of amperes, but this involves making calculations and adjustments continually, which is troublesome, and is likely to introduce errors; any possible gain would be but slight.

As explained above, a test should be repeated until at least two like discharges under the same conditions are obtained; this is very important, and unless this rule is followed the results cannot be relied upon as a correct representation of how the accumulator will act in practice. On the other hand, it is usless to try to carry this out to too great a degree of accuracy. If time does not permit making the comparatively large number of discharges which may be required, tolerably good results, as far as relative capacities are concerned, may be obtained by overcharging the cell each time, so as to get the plates into the same condition before each discharge. But this will make the efficiency calculations incorrect, as the results will be too low, and the actual capacities will be too high.

(*To be continued.*)

* See THE ELECTRICAL WORLD, March 9, 1895, p. 300.

Tests of Fuse Wire.

The tests of fuse wire, made at the University of Pennsylvania on Jan. 17, and of which an account appeared in our issue of last week, were made by Mr. W. E. Harrington, under the direction of Mr. William McDevitt, of the Fire Underwriters' Association.

Fly-Wheel Accidents.

To the Editor of The Electrical World:

Sir:—In your issue of Feb. 8, Mr. Paul M. Lincoln takes exception to the theory of "Fly-Wheel Accidents" as contained in an article from my pen contributed to your issue of Jan. 18. In railway work "bucking" of generators is very common, although seemingly unknown to Mr. Lincoln. His theory in regard to "armature reaction, due to backward lead," means that "bucking" is an impossibility. Carried further, it means that shunt-motors have a backward lead, have their field magnets strengthened as their armature current is increased, and consequently their speed reduced in proportion to the strength of the armature current by its action on the field magnets, in addition to the slowing effect due to load. How could Mr. Lincoln explain why some shunt-motors run faster on a full load than no load? By tracing the path of the lines of force he will see how untenable is such reasoning. The lead is due to the changed direction of the lines of force, and is not "a part of the machine."

The action of the equalizer was fully known and fully considered in the article in question, but not explained because usually understood. Suppose two 10 per cent. over-compounded generators to be running in multiple under very light load, which is the only probable condition for changing to motors. Should the voltage of one drop below that of the other, which would be brought about by the variation in speed causing a variation in voltage greater than the variation in voltage due to sending part of one machine's current through the other's series-winding, then a current would start backward through the weaker machine, the large proportion going through the equalizer, but a portion through the two series-windings—through the generating one in a direction to strengthen its field, but through the motor in a direction to weaken its field. I am well aware that whatever current was being used on the line would be divided between the two series-windings in a direction to strengthen them, and whether the net current in the series-winding would be weakening or strengthening the motor's field magnets would depend upon the proportion of current delivered to the line and to the motor. Even if the net result of the currents flowing through the series-winding of the motor was to tend to strengthen it a little, the armature reaction would quickly weaken its field magnets, or even magnetize them with the opposite polarity, if sufficient current flowed for a little time. I have on several occasions known two large 500-volt compound-wound railway generators, both driven by one pulley, to die almost completely out through the influence of reversal. There being always a little current taken by the line, and a greater proportion passing through its series-winding, the generator would last a little the longer; but I have known the motor fields to be changed so as to start to generate current of the opposite polarity, when started afterward. Should two generators, driven separately, meet the same conditions, it would be a race between the armature reaction weakening the fields and the increase of speed bringing up the counter E. M. F., as to which effect would overcome the other. The armature reaction would be demagnetizing the fields and preparing the way for an increased flow of current, while the motor with the engine attached would be gathering speed, the increasing speed, by developing a higher counter E. M. F. with the weakened fields, checking the flow of current through the armature. The action of the armature and series-winding current is usually quick enough to weaken the fields sufficiently to allow enough current to flow to open an automatic circuit-breaker before the inertia of a heavy engine can be overcome. This is commonly called "bucking." The condition of load on small railway systems is so changeable that any condition of load may occur at any instant and produce any possible effect on the generators. The proportionate resistance of line and motor is such a matter of chance and has such an influence on the action of generator and motor that every possible combination must be fully regarded.

The increase in flow of current through the motor is liable to be checked at any instant by a decreased resistance of the line, and consequent increase of current in the series-winding of the motor tending to strengthen it, and assisting the increased speed in keeping back the current; but an effect of the increased counter E. M. F. and consequent decrease of current through the equalizer would be to strengthen the generator fields and increase its voltage, and the generator, not having had the demagnetizing effect of the armature current without adequate extra field strength to such an extent as the motor, would more quickly recover its normal field strength and voltage; while the motor, having undergone a greater change of magnetism in its fields, would experience to a greater extent the *time* necessary to build up its field magnets. The time required to build up the strength of magnets that have been weakened by the effects of other magnets is remarkable. For instance, I have known two large generators driven by one belt to be both weakened down by one sending current through the other while both were brought down from 500 volts to zero on one, and a very few volts on the other. In this case the one was brought up to normal in about five minutes by its own current, while the other did not build up its own current for fully 20 minutes. Another and more remarkable case was when the same generators were weakened down from 500 volts to about 150 each by the same influence, one circuit-breaker coming out and the other being pulled out and both machine switches opened when down to that voltage. In this case the gain in voltage from 150 volts upward was imperceptible for fully three minutes, and after that time was brought slowly up by cutting resistance out of each rheostat. This time limit I regard as the most important part of the theory of runaway accidents, as the demagnetizing of the fields by the armature is usually so rapid as not to give a motor time to gain quickly enough with its cumbersome load of engine and belting, and if the gain in speed of the engine is unable to keep pace with the demagnetizing of the fields by the armature current, even when helped by the rapid drop in voltage in the generator, due to little current passing through its series-winding, until also helped by a heavier line load, the heavier line load will build up the generator magnets faster than the motor magnets, thus causing further increase in speed to check the flow of current. Where both main wires and equalizers run to a switchboard, and are of the same size and length, the flow of current from the generator through the series-windings will be much greater in that of the generator, as to get through the other it has to traverse three times the length of connecting wire as through its own. This will usually make the proportion of flow through the two windings as 4 to 3 or greater. A flow of current of some hundreds of amperes through a motor represents a vast amount of power, and when expended in speeding up a well-balanced and easy-running engine cannot pass for many seconds without developing a tremendous speed. The Albany accident proved this a matter of only a few seconds.

In conclusion, I would point out as an apparent error of Mr. Lincoln's, the idea that all the series-winding of a compound generator has to do is to cause a magnetism equal to produce the voltage represented by the line loss at the set speed of the generator. Its principal function is to overcome the armature reaction so as to prevent a drop in voltage as more current circulates through the armature. If Mr. Lincoln takes the trouble to test a machine like the wrecked one at Albany, he will find that the magnetism due to the series-winding at full load will, without any current in the armature, cause as great a voltage as the shunt winding.

These accidents are possible and there is almost no limit to the speed at which a motor can be driven by a very possible set of conditions.

The sketch made by J. M. Kent in the issue of Feb. 15 proves that which the author attempts to disprove. Imagine the line circuit open and machine No. 2 receiving current from machine No. 1. In that case current would pass through the equalizer from positive brush of No. 1 to positive brush of No. 2, and thence through the armature of No. 2. In shunt with this path through the equalizer is a path of somewhat higher resistance through the series-windings; through that of No. 1 in a right to left direction and through that of No. 2 in a left to right or *opposite* direction. If the leads to switchboard were all the same size, and the resistance of the series-winding equal to one separate lead, as instanced by Mr. Kent, the current would divide as 2 to 4, the larger part through the equalizer. Any current taken by the line would be divided between the two series-windings in the direction indicated by Mr. Kent. This case would give two currents through the series-winding of No 2. The net value would depend on the proportionate resistance of line and motor. As the generator would only run as a motor on a very light load, the current through the series-winding of the motor on its way to the line would be almost negligible.

Engineer.

Hoboken, N. J.

Secrecy Still Possible.

Prof. Boltzmann remarks that it is fortunate that writing and printing ink are quite transparent to Röntgen rays, for if not, it would be possible to photograph the contents of a letter without opening it.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Armature Windings for Continuous-Current Machines. ARNOLD. *Elek. Zeit.*, Jan. 30.—The first part of an article, partly of a mathematical nature, taken from a prospective work of that author; he endeavors to show that the rules for connecting the windings of cylinder armatures can be put in a better form, and that a better division of the winding is possible; he discusses some of the closed-circuit windings, as also those for multipolar open-circuit machines, among them being that of the new arc-light machine of the Westinghouse Company.

Alternate-Current Motors. RHODES. Lond. *Elec. Rev.*, Jan. 31; a continuation of his series of articles.—He discusses the stationary alternating-current transformer and the induction motor; it is largely mathematical in character.

Theory of Multiphase Motors. BEHREND. *Elek. Zeit.*, Jan. 30.—A short article describing a simple diagram which shows graphically the quantities affecting the operation of a three-phase motor.

Characteristics of Synchronous Motors. KOLBEN. Lond. *Elec. Eng.*, Jan. 31.—A translation with the illustrations of the article abstracted in the *Digest*, Jan. 11.

Transformer. FLEMING.—His second Cantor lecture is abstracted briefly in the London journals of Jan. 31; the abstracts include practical formulas for core losses. The eddy currents in a good transformer iron should not exceed 0.07 watt per pound; there is no use using thinner iron than 0.01 inch, and there is no use in laminating at all unless the lamina are at least 0.04 inch; the maximum permissible hysteresis loss was about 0.33 watt per pound at a frequency of 100, and with an induction of 2500; in ordinary practice transformer plates are about 0.014 inch thick.

Commutator Segments. *Elec. Ry. Gaz.*, Feb. 8.—A full-page table prepared by Mr. Cleveland for calculating the angular thickness of commutor segments.

LIGHTS AND LIGHTING.

Electricity on the Stage. Lond. *Elec. Eng.*, Jan. 31.—Illustrations of some spectacular effects produced on the stage of the Drury Lane Theatre.

POWER AND HEAT.

Niagara Falls Plant. *West. Elec.*, Feb. 15.—It is rumored that if the electric companies can guarantee the efficiency of the dynamos when placed at the bottom of the wheel-pit, the new generators, which are to be installed, will be placed there; this will dispense with the expensive shaft now extending up through the wheel pits.

TRACTION.

Polyphase Currents for Electric Traction. *L'Elettricista*, January.—Messrs. Brown, Boveri & Co., Switzerland, are said to have succeeded in the application of polyphase currents to electric traction; they have completed the equipment of an electric railway near Lugano, the power amounting to nearly 200 horse-power, derived from a waterfall 7 miles distant; it is transmitted as a high-tension, three-phase current, which is transformed down to 400 volts; a double overhead wire and the rails form the three circuits; the motors are said to have the property of automatically keeping the speed constant, the energy being returned to the line on the down grades.

Accumulator Traction. GRUENWALD. *Elek. Anz.*, Jan. 19. A short article giving further information about the line in Berlin, referred to in the *Digest* last week.—The line is 2.55 km (about 1.5 miles) long; the car can carry 31 persons; the Schaefer-Heinemann accumulator is used; the motor is series-wound and has a maximum output of 18 horse-power, the voltage being 250; its weight is 1.2 tons; the complete car without passengers weighs 9.7 tons, of which 3.3 tons are accumulators; the batteries are not removed but are charged in place during the night; a complete cell weighs 26 to 27 kg; the charging occupies 5 to 6 hours; the maximum current density is given as 0.55 ampere per sq. decimetre at which rate the capacity per kg of the complete cell is 12.6 (presumably in ampere-hours); starting the car on a grade of 1 in 67, required 35 amperes and on a level 27 amperes; at full speed the current is 17 amperes; one charge is thought to run a distance of 250 km; when at full speed it can be brought to a stop in a distance of two metres by means of the combined action of the mechanical and electrical brakes.

Jungfrau Railway. *Elek. Anz.*, Jan. 23.—The only question which is still undecided in connection with this mountain railway is, which electric system is best adapted; engineers do not agree on this; it is thought, however, that the first part from the Scheibegg to the Eiger glacier will be begun in April. The question is under consideration to operate the Wengernalp Railway, on which steam is now used, by electricity, and then to use the present rolling stock on that line for building the new one, which starts at the upper terminus of the former.

Electric Traction in Japan. *Elec. Friend* (Japan), December.—There was recently a collision at Kyoto between an electric car and a railway train, on a crossing; the electric car was entirely demolished, three passengers were killed and a number wounded; it is stated that proper safeguards and signals had been provided for. Another item states that the length of the tracks of the horse-car lines in Tokyo is 82,572 feet.

A Large Traction Scheme for London. Lond. *Elec. Rev.*, Jan. 31.—A note stating that an electric traction scheme of considerable dimensions for London is likely to be taken in hand shortly, the necessary preliminary arrangements being in progress.

Double-Trolley System. BALDWIN. *El'ty*, Feb. 5.—An illustrated discussion of the system in use in Cincinnati. Among the advantages claimed he states that if properly wired it is the most economical system, which has been shown by the many failures in trying to run lighting systems with ground return; the cars can be operated over any material giving the necessary traction, and it therefore makes no difference whether the rails are buried in dust or sand; this is an advantage in climbing heavy grades, as both tracks can be heavily sanded, and where a car is off the track it can nevertheless be moved if the wires can be reached by the trolley; there is less danger of burn-outs in armatures and fields, as a single ground will not cause a short circuit; if there is a slight ground it at once produces a disturbance in the telephone at the power house; when a line is broken it does not produce a short circuit; as the rails are not bonded they form a poor conductor, so that a positive wire on the rails at one part of the city would not cause a short circuit if the negative wire should touch the rails at another part; when a trolley wire is down it can in most cases be handled without danger; lightning never seems to give any trouble in the power houses, other than causing the circuit-breakers to open, but in the motors it finds out the weak points. Among the disadvantages he mentions the multiplicity of overhead wires, and greater first cost of the overhead system; a greater number of poles and span wires are required, as also more switches and more complicated crossings; but taking everything into consideration he firmly believes that the double-trolley system will prove the most economical and satisfactory on the long run. A brief description of the overhead construction is given, accompanied by a large number of illustrations of the details; after considerable experience it was found best to use a pair of trolley poles instead of the forked pole which was used at first; he states that this system is not as unsightly and objectionable as one would expect.

Tests of Rail Bonds. DUNNING. *Elec. Ry. Gaz.*, Feb. 8.—A number of resistance tests, the results, which do not admit of being abstracted, being given in the form of drop in volts for various currents; it appears that while the copper bonds got quite hot, the plastic bonds remained quite cold; for currents of about 1200 amperes the drop in volts was as follows: for a No. 00 bond 6 inches long 0.208; with a No. 0 wire 30 inches long added, 0.178; for a plastic bond, 0.035; for the plastic plug bond, 0.628; the rail being considerably lighter; in another about 0.05.

Railways in Massachusetts. *Elec. Ry. Gaz.*, Feb. 8. A brief extract from Part II. of the Commissioner's Report.—There are 1087 miles of street railways in operation in that State, of which 1025 are wholly or partly operated by electricity; the mileage of the electric roads increased 200 miles during the year; dividends were paid amounting to 5.76 per cent. of the aggregate capital stock as compared with 5.97 for the previous year; 42 companies paid no dividends; the average ratio of the original operating expenses to the gross income has fallen in five years from 76.13 to 68.93 per cent. They report unfavorably of the plan of making use of the streets for railway purposes, a source of revenue to the cities.

Electric Railways and Telephonic Disturbances. PRELLER. *Elec. Ry. Gaz.*, Feb. 1.—A reprint in full of the article abstracted in the *Digest*, Feb. 1.

Aix-la-Chapelle. Elec .Ry. Gaz., Feb. 1.—A brief, illustrated description of this plant.

Yonkers. Elec. Ry. Gaz., Feb. 8.—A brief, illustrated description of the railway in that city.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Stations in France. L'Ind. Elec., Jan. 25.—A supplement containing a list of all the central stations in France up to Jan. 1, 1896, together with some tabulated data about each. The total number of stations outside of Paris is 438 against 328 a year ago; the increase is greater in the number of stations than in the power. Considering the source of power they are divided as follows: Hydraulic 182 of 11,665 hp, hydraulic and steam 48 and 7422, steam 128 of 26,802, power gas 6 of 206, city gas 13 of 1605, petroleum 1 of 12, or a total of 378 stations of a total of 47,712 hp, comprising only those about which definite information could be obtained. Of these 293, representing 32,000 hp, used continuous currents, 75 of 15,000 hp used alternating currents and 4 of 850 hp used polyphase currents. If the stations in Paris are included, the total horse-power represented in the stations in France amounts to about 65,000.

Capital Expenditure in Central Stations; supplement of the Lond. *Elec.*, Jan. 31.—A table containing a statement of the capital expenditure of the central stations in the United Kingdom; the total up to Jan. 1 is about $40,000,000, of which about $28,000,000 is expended by companies and about $12,000,000 by muncipalities.

Melbourne. Lond. *Elec.*, Jan. 31.—A brief description of a very successful station, although not of the latest and best type.

WIRES, WIRING AND CONDUITS.

Insulated and Bare Iron Pipe. Bathhurst. Lond. *Lightning*, Jan. 23.—He considers that insulating tubes, or internal insulated metal tubes, are far superior to bare iron piping, for the following reasons: The insulation on the conductors should be surrounded by a preservative rather than a destructive element; it should be subjected to frictional contact only with smooth surfaces; alternation of dryness and moisture should be reduced to a minimum; an envelope not intended as a conductor should be prevented from becoming such; two separate insulating bodies are much better than a single one.

Wiring.—The London journals, Jan. 31, publish the discussion of the Institution papers of Mr. Mavor and Mr. Bathhurst; the discussion contains little of special interest.

Fuse Metals and Other Protection Appliances. McDevitt. *Elec. Eng.*, Feb. 5. A reprint of his report submitted to the Philadelphia Board of Fire Underwriters.—He mentions the fact that too little attention has been given this important subject, and gives the results of a large number of tests and experiments which he made regarding the subject of fuses and their appliances; he points out the gross unreliability of fuse metals and the lack of dependence to be placed on the best designed fuse blocks, coming to the conclusion that in all cases in which the current exceeds 10 amperes, fuses, while generally operating as desired, are a serious fire risk not only in themselves but in their failure as a protector. The results of a large number of tests and experiments are given, as also extracts from recent papers and discussions before the Institute. In conclusion he gives a number of "lessons" and the remedy. Among the lessons are the following: Fuses carry 50 to 200 per cent. of current in excess of the rated fusing current; under short circuits a fuse will carry excessively abnormal currents; fuses made of alloys of low fusing point will remain intact at a red heat, making a serious fire risk; metals such as copper, aluminum, iron, etc., are not adapted for fuse metals on account of the high fusing point; to be reasonably sensitive they must be maintained at a red heat, which is not permissible; fuse metals are and make a serious fire risk; enclosing a fuse is not safe, as the gases generated will continue to carry the current in case of a short circuit; fuse metals are very sluggish, and the current in many places permits the insulated wire or the place of the leakage to become hot; fuse metals are generally unreliable as so many factors affect their fusing point; no standard block and fuse could be established in which some of these factors would not cause a variance in the results. Under the heading of remedy, he points out the advantages of magnetic circuit-breakers, the faults in which, he states, are not comparable to those inherent in fuse metals; such magnetic devices, he considers, should be employed for all circuits carrying more than 10 amperes. He believes that an automatic magnetic circuit-breaker would be entirely satisfactory if it embodied the following particulars: No springs in its adjustment; adjustment made by means of distances; they should open the circuit in less and less time the more the current approaches a short circuit; more energy should be developed than is necessary to trip the retaining catch; the additional energy should be applied directly to opening the switch; if the armature or plunger moves at all it should open the switch; there should be no insulation in connection with the trigger or catch; it is desirable that the catch should not re-engage if the circuit-breaker is thrown in while the fault exists; if intended for damp places, all bearings and like parts should be of phosphor-bronze and the iron parts should be plated; the armature or plunger should not act on the retaining catch without a free preliminary movement preceding such action.

ELECTRO-PHYSICS AND MAGNETISM.

Roentgen Rays. Walker. Lond. *Elec. Eng.*, Jan. 31.—He claims that the recent experiments of Roentgen confirm the view which he published three years ago concerning the nature of electricity; he considers electricity, magnetism and chemical action as modes of motion either of the molecules or of the ether; he considers an electric current to be a series of waves whose lengths are longer than the largest of the invisible heat waves, and whose rate of transmission is lower than that of those waves; electromagnetism consists of a series of waves shorter than the ultra-violet waves and with a higher rate of transmission; magnetism he believes is a wave motion imparted to the molecules of the iron at their formation or to the ether surrounding the molecules; the motion of chemical action is probably between the wave length of the highest sound wave, and those of electricity; Roentgen rays he thinks might be termed ultra-electromagnetic, that is, very short electromagnetic wave.

Elek. Zeit., Jan. 30.—An editorial discussion including a good illustration of a hand. It states that Dr. Slaby, as soon as he heard of the discovery, tried to produce these photographs and found that none of the 20 Crookes tubes at his disposal produced Roentgen rays, and it was not until a new tube was made in which the vacuum was carried so far that the spark length was about the same as that between the leads to the tube, that he obtained the results; the vacuum was about 0.002 mm of mercury; even then he had to use a Ruhmkorff coil of one metre in length and 60 cm in diameter; the illustration above referred to was obtained with this apparatus; it is no better than some of the others which have been published and shows both the flesh and the bones. He also tried photographing directly with the Lenard cathode rays and obtained good results, precisely like those obtained with the Roentgen rays. It is stated that Prof. Puluj has succeeded in obtaining very clear photographs of diseased or displaced parts of bones, and that by the shading it was shown what parts of the bony material had become spongy.

Lond. *Elec. Rev.*, Jan. 31.—A note stating that Dr. Bottomley finds that these rays were clearly foreshadowed in some papers of Lord Kelvin written some years ago; the original paper of Bottomley was contained in *Nature* of the previous week. The Lond. *Elec.*, Jan. 31, reprints extracts from the paper of Boltzmann, which was abstracted in the *Digest* last week.

New Properties of Cathode Rays. Perrin. *L'Ind. Elec.*, Jan. 25.—An Academy paper in which he describes the results of certain investigations. Crookes and others believe that these rays are formed of negatively charged material having a great velocity; the present writer made some experiments to see whether this hypothesis agrees with all the facts known at present; he believes it has not been demonstrated that the cathode rays are charged negatively; a special tube was constructed, an illustration of which is given, for determining this and he found that these rays are charged with negative electricity. He then endeavored to find what became of the corresponding positive charges and finds that they travel in the opposite direction, precipitating themselves on the cathode, and that the positive charges are of the same order of magnitude as the negative; the negative electricity is radiated from the cathode while the positive travels toward the cathode. In endeavoring to see whether this positive flux forms a second system of symmetrical rays, he found that the action of the positive flux is real but very feeble, and increases as the pressure decreases; with the aid of a magnet the action can be totally suppressed. His results do not concur with the theory that the cathode rays are ultra-violet light rays, but they agree well with the theory that there is a material radiation, which he describes as follows: In the neighborhood of the cathode the electric field is sufficiently intense to break up into particles, into ions, certain molecules of the remaining gas; the negative ions go toward the region where the potential increases, acquire considerable velocity and form cathode rays; their electric charge, and therefore their mass, is easily measurable; the positive ions move in an opposite direction, forming a sort of diffused tuft which is affected by a magnet, and is not a true radiation.

Absorption of Cathode Rays. Lenard. Lond. *Elec. Rev.*, Jan. 31; a continuation of his article, see *Digest* last week.—He discusses the absorption in solid media and gives the results of a number of interesting experiments; he found that the absorption in aluminum is very nearly what one would expect for any gas of the density of aluminum, that is the ratio between the density and absorptivity remain the same for gas and aluminum notwithstanding the change in molecular constitution. Different metals are compared with each other, their absorptivity being measured by means of photographic plates; when the thickness of the foils are chosen so that their weight for the same surface is equal, instead of the thickness being equal, their shadows can be distinguished only with difficulty as they are so nearly alike; he concludes that equal masses therefore absorb the same amount of cathode rays; that is, the absorptivity and density are proportional to one another and their ratio is therefore a constant. He also compared other solid substances with aluminum and finds that as a first approximation the same law holds for paper, glass, collodion or mica; the experiments also show that small deviations from that proportionality do exist; these deviations appear to be different for different kinds of cathode rays as exactly equal shadows could be occasionally distinguished as different, when the pressure in the tube was varied. Among the tables of data he gives one containing the

absorptivities, densities, and their ratio, for gaseous and solid bodies; the ratio is approximately a constant equal to an average of 3200; these results are true only for the cathode rays used in experiments.

Theory of Cathode Rays. JAUMANN and POINCARE; *Comptes Rendus* for the meeting of the 13th of January.—A mathematical discussion.

Longitudinal Light. POINCARE. Lond. *Elec.*, Jan. 31.—A translation of the article abstracted in the *Digest*, Dec. 14, under *Cathode Rays;* see also *Digest* last week.

Electric Resistivity of Metals in Different Dielectrics. GRIMALDI and PLATANIA; *Nuovo Cimento*, 4, 2, page 39; abstracted in the Lond. *Proc. Phys. Soc.*, December.—This is the paper referred to by Prof. Sanford in the abstract in the *Digest*, Nov. 30. (See also Dec. 14.) The net result of their observations is that copper in petroleum is more conductive than copper in air, in the ratio of 1.00015 to 1.00000, which is about 1-12 of Sanford's results; they attribute this difference, between his and their results, to the want of delicacy of his thermometers.

Currents in Open Circuits and Dielectrics. NIKOLAIEVE. *J. Phys.*, 4, page 245. Abstracted in the Lond. *Proc. Phys. Soc.*, December.—The mechanical actions accompanying the induction in a variable field are used for studying the currents induced in open metallic circuits and in dielectrics, the latter being made the seat of alternating currents.

Periodic Currents and Conduction. TUMA. *Wien. Ber.*, 104, page 470; abstracted in the Lond. *Proc. Phys. Soc.*, December.—The paper which was abstracted in the *Digest*, Nov. 23.

Heat Developed by Superposed Currents. Lond. *Elec.*, Jan. 31.—The time integral of the square of the composite current, consisting of a superposed continuous and alternating current, is equal to the sum of the separate time integrals of the squares of the separate currents; the heat generated by 10 continuous amperes and 10 alternating amperes flowing through the same conductor is therefore only half that generated by 20 continuous amperes flowing through that same conductor. (This result was brought out in a discussion of the system illustrated in THE ELECTRICAL WORLD, Dec. 21, page 673.)

Spark Spectra. GRAMONT. Lond. *Elec. Rev.*, Jan. 31.—A brief recommendation of the original paper in *Comptes Rendus*, Vol. 121, p. 121, in which he refers to the spectrum analysis of minerals and fused salts. Many of the minerals have sufficient conductivity or volatility to permit the passage of a condenser electric spark between the small fragments attached to the pole of the coil; the spectrum then shows the lines of both the metals and the non-metals; without the condenser the spectra of the non-metals disappear and those of the metals show only the brightest lines. Certain fused salts behave in a similar way; with the condensed spark the lines of all the elements are brought out; without the condenser the spectra are complex and characteristic of each salt; he suggests that such spectra are probably produced by undissociated molecules; the condensed spark is best for minerals and the one without the condenser is best for salts.

Hall Phenomenon in Liquids. BAGARD. *L'Ind. Elec.*, Jan. 25.—An abstract from an Academy paper stating that he found the phenomena manifesting itself to a high degree in solutions; quantitatively the results are of the same magnitude as those obtained with bismuth, which is many thousand times greater than for most other metals.

Circular Magnetization of Iron Wires. KLEMENCIC. *Elek. Zeit.*, Jan 30; an abstract of a paper read before a Vienna society.—If a current is passed through an iron wire it will produce circular magnetization in the wire; he believes that two questions have not yet been answered by the experiments so far made; first, in what relation are the permeability and the magnetizing force for this circular magnetization, and, secondly, what is the relation between the permeability of the axial and that of the circular magnetization; he investigated these two questions experimentally and finds that variations of the susceptibility was similar for both the axial and the circular magnetization but quantitatively there is an important difference; with soft annealed iron the susceptibility in a circular direction is less than in the axial; when the iron is hardened by stretching, the susceptibility in the axial direction is lessened more rapidly than in the circular, and that for soft iron they may even be reversed; with Bessemer steel the circular susceptibility is decidedly greater than the axial; the permanent magnetism of soft iron is about the same in both directions; with hard iron and Bessemer steel it is larger for circular magnetization and the difference is quite great, especially for weak fields.

Vertical Earth Air Currents. RUCKER. *Phil. Mag.* for February.—A reprint of the article abstracted in the *Digest* Jan. 18 (incorrectly attributed to KAY).

Magnetic Elements. MOREAUX. *L'Ind. Elec.*, Jan. 25.—An Academy paper giving the absolute values of the magnetic elements of the earth for the first of January.

Roentgen Rays. ELIHU THOMSON. *Elec. Eng.*, Feb. 12.—In a brief article on "Cathodographic Experiments," he suggests different forms of apparatus. He believes that any activity in the solar rays can hardly be expected, as those which reach us have passed through a great depth of air, the absorptive power of which is very great; besides, it would then be impossible to keep photographic plates in the way they are kept. He favors the hypothesis attributed to Lenard, that cathode rays are simply invisible rays far beyond the violet end of the spectrum, that is, ether waves of very short wave length; violet rays have magnetic properties, and there is therefore apparently a relationship between magnetism and both violet light and cathode rays. Various forms of the apparatus which he suggests are shown; the object is to develop cathode rays of great power, high-frequency, high-potential currents being used; a glass vessel in the form of an oblate spheroid has an opening on one side covered with a thin aluminum cap; this not only forms a window for the escape of the rays, but also a metallic conducting coating which is connected as one of the electrodes, the other being directly opposite to it and may be the exterior cover of glass; the concavity of the latter could be made such that the rays would be concentrated through the opening; to prevent heating it would be advisable to immerse such a bulb in oil; in a modification he uses thin glass and electrodes only on the outside surfaces; in another like it, there are openings in the glass on both, the cathode rays being then generated in both directions; he has no doubt that by carefully selecting incandescent lamps in accordance with their vacuum, which is frequently a Crookes vacuum, they could be used as cathode ray generators by putting two thin aluminum caps on opposite sides of the bulb; to operate from a distance he proposes passing the rays through a vessel containing hydrogen or through a vacuum, as the absorption is then less.

The same journal contains a brief report of the experiments of Mr. Edison, a mention of which was given in THE ELECTRICAL WORLD last week; he believes that their effects on the photographic plates are due rather to direct mechanical than to chemical action; he made a large number of experiments which he believes prove that the vacuum required is largely dependent on the voltage, the best point at which the lamp should be sealed off being that at which all the glow in the interior ceases, and fluorescence of the glass alone is observed; he uses aluminum discs for both electrodes as they keep cooler; he also tried carbon but it seems to offer an abnormally high resistance and becomes white hot; the most transparent of a number of different materials was found to be celluloid; while glass was almost as opaque as steel. Mr. Case, in the same journal, states that he placed a photographic plate in its paper case between two metallic discs six inches apart connected to the terminals of an induction coil giving a half-inch spark and obtained a shadow photograph of pieces of metal in about 15 minutes; it seems that the rays pass in straight lines from one plate to the other.

A translation of the original paper of Roentgen, which was abstracted in the *Digest*, Feb. 8, is published in full in the *Elec. Eng.*, Feb. 12; *West. Elec.*, Feb 15, and *El'ty*, Feb 5.

The *Elec. Rev.*, Feb. 12, publishes a brief interview with Prof. Dolbear. In 1892 he photographed a five-pointed iron star by means of electric sparks through an ordinary table top about one inch thick, the star being placed on a piece of photographic paper in the table drawer; a fair outline of the star was produced, the source being a Wimshurst machine. He disagrees with Roentgen in his belief that his rays are different from cathode rays; Dolbear believes that the same results could be obtained from any source of light; sun's rays striking on any object will be partly absorbed and partly transformed from very short to long rays, depending on the kind and thickness of the object; the same practically holds good in gas or arc-light rays. Some quotations are given from his article in the *Cosmopolitan* of April, 1894; in this he states, among other things, that what any ray can do depends on the kind of matter it falls on so that all rays have similar characteristic properties; there is no peculiar kind of ether waves which can be called light as distinguished from other ether waves, as what is called light has no existence apart from the eyes; it has long been known that photographs may be taken with ether waves much too long to be seen by the eyes, if some other substances are used in place of the silver salts. If a coin is placed on a piece of photographic paper and a few sparks from an electric machine fall on it, there will be an imprint of the coin; it is not necessary to have the sparks fall on it if the whole, enclosed in a dark box, is brought near an electric machine which discharges with a series of sparks between its terminals, the ether waves set up by it being sufficiently short to affect the photographic surface; "so it is actually possible to take a photograph of an object in absolute darkness with the ether waves set up by working an electric machine."

The *West. Elec.*, Feb. 15, reproduces some shadow photographs made in Chicago; an unsuccessful attempt was made to photograph fractures in the bones above the wrist. An attempt was made to stop down the rays with a leaden diaphragm having a half-inch aperture, but the results are not given. The apparatus used consisted of a Ruhmkorff coil connected to a Crookes tube, the primary current being obtained from accumulators passed through an interrupter driven by a motor; the coil gave a 3-inch spark; the photographs which are reproduced are fairly good.

El'ty, Feb. 12, contains a short communication from Dr. Pupin; he states that an under-exposed plate fails to bring out the relative absorptive powers, that is, if the exposure is too short no details will be shown; in obtaining shadows of a pair of spectacles he found that after long exposure the varying thickness of the lens is seen on the negative; in the photograph of a hand there is no trace of the skeleton unless the exposure is sufficiently long; a Wimshurst or Holtz machine can well be

used in place of the more complicated apparatus generally used; these machines could be used to charge a Leyden jar, which is discharged disruptively through a spark gap; he thinks better results can be obtained with static machines since a higher potential can be used and the discharges can be of a much more disruptive character, which seems to improve the results considerably; his experiments with these machines are, however, not yet sufficiently numerous to enable him to come to definite conclusions; in the diagram of the connections two Leyden jars are shown with their inner coatings connected to the machine, and to the discharge knobs, while the Crookes tube is connected between their outside coatings. By a proper curvature of the wall of the bulb containing the electrode on the outside, the fluorescent spot on the opposite side may be made as small as desired; he considers the prospects of the practical applicability to surgery and metallurgy as very bright. The same journal states that the Presbyterian Hospital and the Surgical Department of Columbia College are being equipped with the necessary apparatus.

The *Eng. & Min. Jour.*, Feb. 8, quotes Dr. Pupin as saying that his experiments with the spectacles, above mentioned, indicate "that the X-ray acts upon objects in a chemical manner, eating its way through them, as it were, like acid."

Movable Light Phenomenon. Elster and Geitel; *Ann. Phys. u. Chem.* No. 12, 1895; abstracted briefly in the *Amer. Jour. of Sci.* for February.—In the course of an investigation with cathode rays they noticed a remarkable movement of the rays which evidently was due to a wave motion; they used a Lenard apparatus; the cathode rays could apparently be formed in the rarefied chamber as if they proceeded from an electrode in the rarefied media, entirely apart from the metallic cathode; the streams could be made to extend from one portion of the glass wall of the Geissler tube in a bent form to another portion; the authors conclude from their experiments that the cathode rays are due, not to matter repelled from the electrode, but to movements of the ether.

Discharge Through Gases. Ann. Phys. u Chem., Nov. 12, 1895; abstracted in the *Amer. Jour. of Sci.* for February.—If a discharge tube is surrounded by water, alcohol, turpentine or other media the discharge no longer takes place; the effect is not due to conduction; if a point electrified by a Holtz machine is moved near the tube the discharge is facilitated.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrometallurgy in 1895. Andreoli. Lond. *Elec. Rev.*, Jan. 31.—A brief review of some of the more important developments during the last year. He believes that the progress has been extremely encouraging and promises to lead to great commercial development; some of the more important processes are discussed; the Siemens process has been used with success with the blende in an Australian mine which is very rebellious to the ordinary treatment; it contains zinc, lead, silver, copper, sulphur and iron, and it has heretofore been impossible to separate the metals profitably; the process is simple and effective and consists in sulphatizing the ores and electrolyzing a sulphate of zinc, the electrolyte circulating rapidly in combination with a stream of compressed air, producing a solid deposit of zinc; he states that commercial electrolysis in mining districts is rendered prohibitive if porous diaphragms are required; no such diaphragms are required in this process; the anodes are of lead and the cathodes of zinc; the electrolyte consists of oxide of zinc dissolved in sulphuric acid; the current is 50 amperes per square metre of cathode. The Asheroft process, which is intended to be applied to these same refractory ores, is discussed unfavorably; he first oxidizes the ores then leaches with ferric sulphate and electrolyzes the zinc sulphate in which the iron has been precipitated; porous diaphragms are required; he considers it inferior to the Siemens process. The Tommasi system is briefly discussed; polarization of the cathodes is prevented by reducing the resistance of the electrolyte to a minimum, by keeping it homogeneous and by separating the metals from a binary or ternary compound with the aid of electrodeposition and chemical precipitation. He discusses unfavorably the so-called hydrogen amalgam said to have been invented by Molloy and which he thinks does not actually exist, believing that it is simply an ordinary sodium amalgam; the electro-amalgamation in connection with the gold cyanide solution is theoretically an absolutely perfect process, but in practice it is not so successful unless the circulation is very slow, requiring an enormous quantity of mercury; the process is not a bad one, but it will not revolutionize the gold industry; it has been suggested to use amalgamated plates separated by diaphragms, but he does not favor this, as there is no need of diaphragms in electro-depositions of gold which takes place readily without them. A few other processes are briefly described; electrolytic extraction of gold from its ores is briefly discussed; the Pielsticker apparatus is not what it ought to have been; neither carbon nor iron make a good anode in cyanide solution; it may safely be contended that electrolysis can recover gold in a pulverized mass from the ore containing it and that given two identical samples with the same quantity of cyanide of potassium, the one which will be treated by electrolysis will show much more gold dissolved than the simple lixiviation process; the electrodeposition of gold is as important as its dissolution in the cyanide; about 50,000 tons of gold solution are treated by the electric current in the Transvaal alone by the Siemens process, thousands of ounces of gold being deposited every month; but the process is inadequate; the iron anodes are destructible, contaminating the solution; he believes the gold deposition of the future will be based on the use of insoluble anodes, and the cathodes, from which the gold will be directly recovered as a metal, will be used over and over again.

Dissociation Degree of Some Electrolytes at 0°. Watt. *Phil. Mag.*, February.—He gives briefly some of the results of investigations which indicate that in dilute solutions the dissociation degree is practically independent of the temperature.

Theory of the Lead Accumulator. Liebenow. Lond. *Elec Rev.*, Jan. 31.—A translation of the article abstracted in the *Digest*, Feb. 8.

Storage Battery Patent.—The Faure patent expired in Germany on Feb. 8 of this year.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Continuous and Alternating-Current Magnetic Curve Tracer. Moore. *Phil. Mag.*, February.—An illustrated description of the instrument used in the magnetic observatory of the Princeton University and a description of the method of using it. He refers to an older method called the alternating-current magnetometer method, which was described in The Electrical World, Feb. 4, 1893, over which the present one is considered to be an improvement. The instrument is independent in its action of the time required to complete the cycle; it is accurate, reliable and can give the indications in absolute units; the number of observations required are reduced to a minimum; it reads directly and the measurements are made quickly. A system of two small helices, the coils so suspended and mechanically connected that any angular displacement about a vertical axis which is given to the one is imparted to the other also, while one of the two helices may receive independent angular displacements about a horizontal axis besides.

Determination of Large Electrolytic Resistances. Maltby. *Zeit. Phys. Chem.*, page 133; abstracted in the Lond. *Proc. Phys. Soc.*, December.—He describes the application of a method for determining electrolytic resistances proposed by Nernst, consisting in the use of a Wheatstone bridge formed of four electrolytic resistances, the unknown resistance being found by measurements with it, alternately in and out of the bridge; electrostatic disturbances are compensated for by two variable condensers shunting the arms of the bridge; balance is obtained by telephone or by an electrometer; the bridge resistances were made of a solution of mannite and boric acid, with a small quantity of potassium chloride to compensate for the small negative temperature coefficient; the liquid is contained in U-shaped tubes having one fixed and two adjustable electrodes; resistances from 100 ohms to 30 megohms can be determined; two of the resistances are made equal and the unknown is then inserted in series with one of the adjustable resistances while the other is altered until balance is obtained; measurements are made in terms of divisions of the U-tube which have been calibrated.

An Acetylene Photometric Standard. Violle. *L'Elec.*, Feb. 1, and *L'Ind. Elec.*, Jan. 25; reprint of a short Academy paper.—He considers that a gas of invariable chemical composition burning under definite conditions could be used for a secondary standard; he believes acetylene could be used in this way; the flame is perfectly fixed, very bright and has a remarkable whiteness, the brilliancy being practically uniform over a large surface. He recently had such an apparatus constructed by Carpentier; the flame had about 100 cp under a pressure of 0.30 m of water; it consumed 58 litres of acetylene per hour. Spectro-photometry showed that this light differed very little from that of platinum at its fusing point, which was used to define the absolute unit.

Determining Self-Induction Coefficients with Alternating Currents. Kolacek. *Wied. Ann.*, 55, page 604; abstracted in the Lond. *Proc. Phys. Soc.*, December.—A closed coil is placed in a periodic magnetic field; the value of the corresponding average forces are given in a formula, from which the self-induction coefficient can then be calculated.

Use of a Ballistic Galvanometer when the Discharge is not Instantaneous. Weiss. *J. Phys.*, 4, p. 420; abstracted in the Lond. *Proc. Phys. Soc.*, December.—He gives two proofs showing that "if the distance traveled by the needle is an infinitely small quantity of the first order, compared with the amplitude, this latter measures the difference between the discharges to an infinitely small quantity of the second order."

Potentiometer. Fisher. Lond. *Elec.*, Jan. 31.—A continuation of his long article, *Digest*, Feb. 8. He discusses the difficulties encountered in the construction of the galvanometer, and describes the method of using it.

Protecting Instruments from Return Railway Currents. Froelich. *Elec. Ry. Gaz.*, Feb. 8.—A reprint of a translation in abstract of the paper abstracted in the *Digest*, Dec. 14.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Military Telephone. Charollois system. *La Nature*, Feb. 1; an illustrated description.—He uses a single wire and an earth return made by sticking sabers into the earth and connecting the wires to them; the single wire, which is laid on the earth, is not insulated, as his experiments showed that a bare wire run over the earth without any special precaution to insulate it retains the property of conducting to considerable

distances, amounting to at least 12 miles, the currents necessary to operate the telephones, and this is true even for magnetic telephones; he prefers a bi-metallic wire, the outside of which is copper and the inside steel, as this combines all the desired qualities. The whole telephone apparatus is carried on the back of a man in a position ready to be used, the reel of wire being carried in his hand, and the earth connection being made with his saber.

Long-Distance Telephony in Japan. Elec. Friend (Japan) December.—Experiments were recently carried out at midnight when there were few telegraphic messages, on the line from Tokyo to Kobe, 376 miles, passing Yokohama, Nagoya, Kyoto and Osaka; the circuit is metallic and is made of copper wire, the lines crossing each other at several points to prevent inductive disturbances; the "Elecsson" type of transmitter was found to be the best; the results of the test were very successful and the government is preparing to open these long-distance lines to the public before long.

Lightning Arresters. Elek. Zeit., Jan. 30.—Brief, illustrated descriptions of those used for telephone lines in Wurtemburg and in Switzerland.

An Early Magnetic Telegraph. Elek. Zeit., Jan. 30.—A short article stating that the French journal *Cosmos* recently reprinted an abstract of a book published in 1622, in which a method was spoken of by means of which two persons could communicate with each other by means of magnets; the magnets in the form of needles were mounted on dials containing the 24 letters; the sender will move the needle to the desired letters in succession, and the second needle will then move synchronously. When the apparatus was shown to King Henry the inventor was forbidden to publish a description of it, as it was feared that it might be dangerous in the hands of his enemies. The German journal adds that this apparatus was probably the one which was described by Porta in 1553 and was referred to a number of times in the beginning of the seventeenth century; it adds that the greatest distances at which it would be possible to use such a system is at most one to two metres.

MISCELLANEOUS.

The Aluminum Industry. ADDENBROOKE. Lond. *Elec. Rev.*, Jan. 31.—He believes that the past year has been a turning point of no mean importance; aluminum has suffered much from extravagant pretensions which were made on its behalf and which are proved incorrect; he compares the relative costs of aluminum and copper, showing that for most purposes aluminum is only a little more expensive than copper, in fact the prices of saucepans and stewpans show that they are actually cheaper in aluminum than in copper; it has a much better chance of becoming the electrical conductor than has until recently been expected; according to text-books aluminum is a better conductor than copper, weight for weight, in the proportion of about 1 to 1.8, and consequently if its price can be brought down to that of electrolytic copper, say about 11 cents per pound, it will quickly take the place of the latter in most cases as a conductor. His investigations had led him to suspect the published figures for the conductivity of aluminum, believing that the samples may not have been quite pure; he mentions some recent tests made with specially pure metals, which showed a slightly higher conductivity than that given in books and concludes that the conductivity is probably not more than 60 per cent. that of copper; Lord Kelvin tested some more recent samples and obtained higher results, namely 68.5 per cent., which he says may be relied upon safely as representing our present knowledge; the figure usually given in text-books is 56 per cent., showing that recent progress has raised this by 21 per cent.; the diameter of an aluminum wire of the same conductivity as a given copper wire will therefore be only 15 per cent., or less than one sixth, greater; copper has about 3.3 times the weight of aluminum, and the weight of an aluminum wire of the same conductivity would therefore be four ninths, or considerably less than one half; it is thought that before long the resources of metallurgy will bring the cost of aluminum of this purity down to a moderate amount; he claims that aluminum is just as easy to work as copper (he does not mention, however, the greater difficulty in making soldered joints); it would be an advantage to use it for heavy cables and also for overhead conductors, as the weight would be reduced one half; as a conductor it is now about twice as expensive as copper, and he believes that the inevitable improvements which are taking place, and the expiration of patents, will diminish the difference between aluminum and copper and obliterate it before long. (He does not mention that where the volume is important, as in dynamo construction, for instance, the advantages of using aluminum instead of copper are not so evident).

Calcium Carbide and Acetylene. HOSPITALIER. *L'Ind. Elec.*, Jan. 25.—An article of a general character; his conclusions are that he does not believe acetylene, produced from the carbide, will ever be a formidable rival either of city gas or of electricity from central-stations; but there is a place for it which is not filled by the present methods of lighting, namely, in connection with large buildings too far away from cities; the electric central-stations may then be able to use their power during the day for the production of this material, but a fear exists that in the near future carbide of calcium may be obtained by an exclusively metallurgical process, or, as a bi-product, at a price much lower than that at which it could be produced electrically.

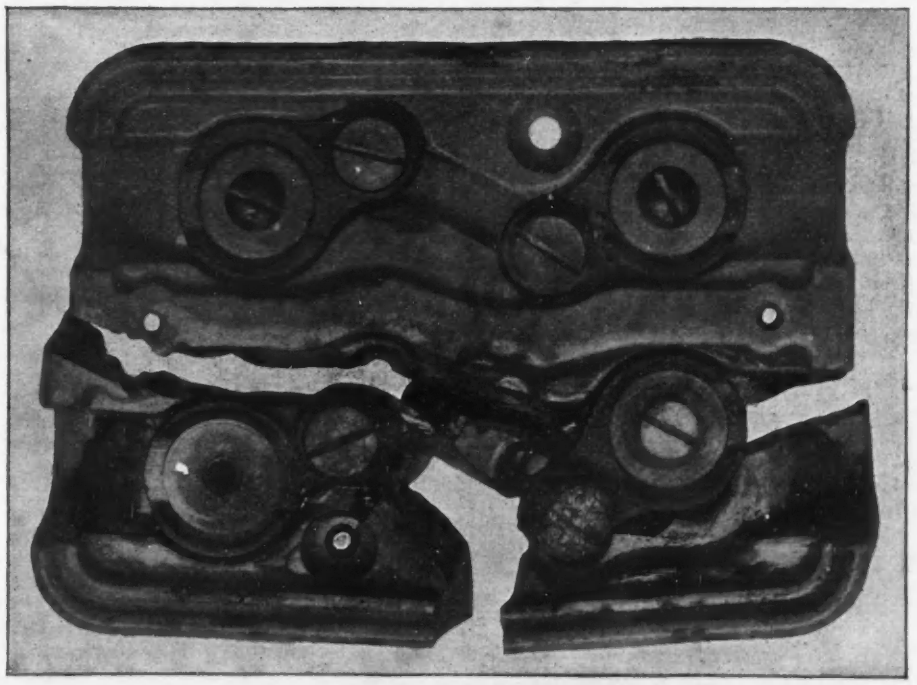
Metallic Cement. Elek. Anz., Jan. 19.—A Swiss company is making a patented metallic cement, which melts at about 250 degrees C., about like lead, and can be cast into the finest forms; it adheres like sealing wax to all materials, as stone, masonry, metal and wood; it is not affected by water, acids or oils; it expands slightly on cooling, which is said to increase its power of adhesion; its specific gravity is only 1.5.

Abstracts.—The Lond. *Proc. Phys. Soc.* for December, contains a very complete index of the abstracts in their publication for the past year; it is divided into an authors' index, a subject index, and a general index.

Inaugural Address. HOPKINSON. *El'ty*, Feb. 12.—The beginning of a reprint of the address abstracted in the *Digest*, Feb. 8, under "*Electricity.*"

Tests of Metal Fuses.

Mr. William McDevitt, inspector of the Philadelphia Board of Fire Underwriters, recently submitted a report to that board containing among other matter an account of a number of recent tests made for him by Mr. W. E. Harrington of fuses across a 100-light, 110-volt dynamo. A Weston ammeter, a water rheostat, a main switch and the fuse blocks were all in series. A short-circuiting switch around the fuse was used in most instances, permitting the current to be adjusted by means of a water rheostat before throwing it upon the fuse to be tested. In many instances commercial fuse blocks and standard metals were employed. We illustrate herewith one of the blocks used in the test. This is a standard-link, main-line double-pole fuse block, rated at 50 amperes. When tested the block rested as shown and was fused with a metal fuse link rated at 50 amperes. The fuse carried 70 amperes for 45 seconds; and when the current was increased by increments of five amperes, the fuse blew irregularly up to 125 amperes, being one minute at 75 amperes, one minute at 120 amperes and ranging from 10 to 35 seconds longer with some of the currents between these limits. At 130 amperes the fuse blew



FUSE AND BLOCK AFTER FINAL TEST.

in 2 minutes and 15 seconds and arced for 1 minute and 7 seconds. The No. 6 copper leads became hot, and with the final current the block was destroyed. It will thus be seen that though the fuse was rated at 50 amperes it withstood a current of over two and one half times that for more than two minutes. A great number of tests were made, and all of them showed fuse metal to be unsatisfactory in scarcely a less degree than in the test quoted.

Mr. McDevitt concludes his report by offering a remedy, which consists in the exclusive use of magnetic circuit-breakers, and he gives the following as what he considers should be the features that an improved type

of automatic circuit-breaker should include. 1. The magnetic circuit-breaker should open the circuit in less and less time as the conditions of the current protected approach the short circuit; that is, have an inverse time element. The electromagnetic part of circuit-breakers should be designed to develop more energy than is necessary to trip the retaining catch, the additional energy developed to be applied directly to aid in opening the switch. 2. A magnetic circuit-breaker should have no springs for its adjustment. 3. Insulation should not enter into the construction of the trigger or catch. 4. All bearing pins and parts liable to be affected by corrosion or rust should be of phosphor-bronze and all iron parts copper-plated. 5. The armature and plunger of the magnetic circuit-breaker should not act on the retaining catch or switch, unless a free preliminary movement preceeds such action.

Cotton Mill Electrical Plant.

The electrical equipment of the extensive cotton mills of the Pelzer Manufacturing Company, one of the largest cotton goods manufacturing concerns in the South, is rapidly nearing completion. The motive power is derived from "Victor" turbine water-wheels driving three 750-kw three-phase generators, wound for 3300 volts. The water-wheels turn at a speed of 164 revolutions per minute.

The electricity generated at the power-house will be carried a distance of three and a half miles to Pelzer, where it will enter the mills and drive the following motors: one 400-hp synchronous motor wound for high potential, and three multiphase motors of varying capacities from 5 horse-power up to 110 horse-power. The majority of these motors will be of the inverted type, suspended from the ceiling in the different rooms. They will receive the current at a low potential from step-down transformers placed in a sub-station at the mills. The mills will also be lighted from the same circuit.

The system utilized in the operation of these mills is the three-phase system developed by the General Electric Company. By means of this system it is now generally conceded that long-distance power transmission may be most economically effected. This same system is in use at the Columbia Mills at Columbia, S. C., and at the Ponemah Mills at Taftville, Conn.

Scale Wire Bridge.

Among recent advances in electrical testing instruments is a portable bridge and testing set now being placed on the market by the Buffalo Instrument Company, of Buffalo, N. Y., and claimed to be an entirely new departure. A general view of the instrument is given in Fig. 1, showing it with the outer case and batteries. The bridge is contained in a mahogany case separate from the batteries. There is but one plug to this bridge, which reduces the liability of variable resistance through bad contact of plugs to a minimum. Fig. 2 is the diagram of the apparatus.

The variable resistance of the bridge is composed of a continuous scale wire, 500 inches in length, stretched around suitable insulated pins at the end of a table. Under the table is a chart divided into 1000 half inches; each half inch is divided into 10 degrees, which virtually divides the scale wire into 10,000 separate units or degrees. The chart facilitates reading the scale in making measurements.

The standards of resistance or multipliers of the bridge are 1 ohm, 10 ohms, 1000 ohms and 10,000 ohms respectively. The standards are calibrated to embrace one half of the scale wire, 5000 units or degrees of the scale (from *A* to *B*, Fig. 2), while the other side of the coils is connected to multiplier post *D*. The standard would be from letter *B* to *A* to *D*. The unknown is across the remaining leg of the diagram (from *D* to *XX*).

One side of the receiver or galvanometer is connected to *D*, the other side being at *C*, which is a finder or contact to be used in the tracing the

Fig. 1.

neutral point over the scale, between *XX* to *B* and *A*. The battery connects between points *A* and *XX*.

To find the neutral point, the finder or pointer *C* is drawn over the manifolds of the "scale wires." It is readily determined on which wire the neutral point lies, as the receiver indicates a sharp, loud sound, except when at the neutral point or close to it, when it becomes weaker and finally is silent at the neutral point. Readings taken with this style of receiver have proved to be fully as sensitive as with the ordinary galvanometer, and in many instances much closer results have been obtained with it. The chart under the scale wire gives the degree of the scale. By referring the degree of the scale to a table contained in the cover of

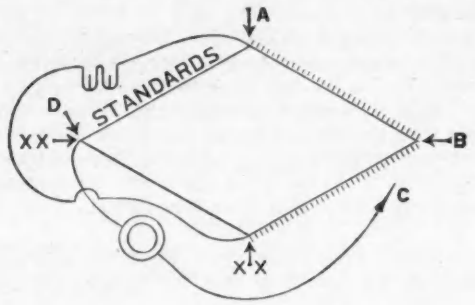


Fig. 2.

the instrument there is found the direct reading of resistance of the bridge, from .0001 ohm to 99 megohms. This obviates all necessity of figuring the resistance from the standards. It will be readily seen that any person can operate this style of instrument, as it is so simple that all that is required is to make the test, there being no adjustment of the instrument necessary before it is ready for use, and the table is carried out to its full range.

New Orient Lamps.

We illustrate herewith several forms of lamps manufactured under the name of "New Orient" by the Orient Electric Company, Youngstown, O. The lamp shown in the middle is of the miniature type and the two

New Orient Lamps.

others are regular commercial forms, one having, it will be noted, a coiled filament and the other a twisted filament. The manufacturers state that they make these lamps only in high grades, using the best material and highest class of machinery and skill that the market affords. To further insure the reliability of its product, the greatest pains is taken in testing, for which an elaborate equipment has been installed. Every lamp is independently tested by three persons, and with as many different instruments, before it is permitted to enter the stock room.

The Electro-Magnetic Traction System.

Mr. W. J. Carruthers Wain, A. I. C. E., F. S. S., president of the Tramway Institute of Great Britain and Ireland, while recently in the United States made a thorough examination of the McLaughlin system of electric traction, as operated upon an experimental line laid down in the yard attached to the Electro-Magnetic Traction Company's works in Philadelphia. The report was prepared at the request of Mr. Auchinvole, of Glasgow, and Count J. des Garets, of Paris.

The Electro-Magnetic Traction system may be briefly described as follows: Between the track rails a third rail is laid, which is divided into insulated sections. As the car passes over these sections they are successively connected to the positive terminal of the dynamo, and the current thus finds its way to the motors, returning through the rails to the station. The contact section is cut out before the car has completely passed over it. A sketch illustrating the principles of the system is shown in Fig. 1. The negative terminal of the dynamo is attached to the rails, while the positive feeder makes connection with each of the contact boxes *bb*, and by suitable mechanism is connected and disconnected to the sec-

tion of the third rail, *RR*, at the proper intervals. The general appearance of the track construction is shown in Fig. 2.

The lid of the box, shown in Fig. 2, is of a non-magnetic composition of iron and brass, and is hermetically sealed to prevent the entry of moisture. Immediately under the lid are two armatures which are alternately attracted by corresponding magnets on the car. When a car passes over a section of the centre rail, the car magnet just clears the lid of the box and this causes one of the armatures to become elevated, the other being thereby depressed. This closes a switch in the box, and the current is thus communicated to the centre rail, which only becomes alive by this means; immediately after the car has left the section, the current is switched off by the action of a second magnet under the rear end of the car, attracts the second armature, and thereby depresses the armature previously elevated by the passage of the first magnet over it. By means of an ingenious gravity latch, the switch is locked when a car is not passing over a box. These operations are repeated over the entire length of the line. It will thus be seen that any section of the centre

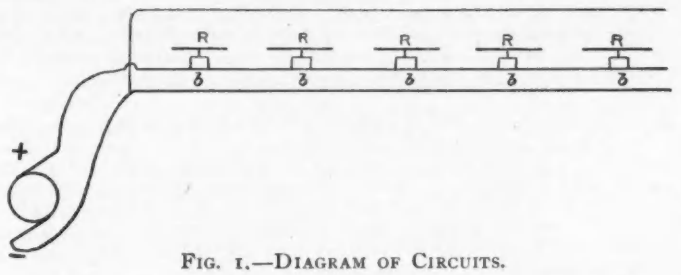


FIG. 1.—DIAGRAM OF CIRCUITS.

rail immediately under the car is charged with current only when the car is passing over it. The current is collected from the centre rail and conveyed to the motor on the car by means of a wheel protected by a small sweeper in front and behind.

The report concludes with the following summary of the result of Mr. Wain's examination of this system and his study of its details:

(1) The system is simple and cheap in construction. Apart from the cost of the ordinary permanent way and paving, the expense of laying should not exceed £3600 per lineal mile.

(2) It can be adapted to any existing line of tramways, as nothing in its construction interferes with any existing permanent way except in the few cases where slot-rails are used for lines worked by cables or some

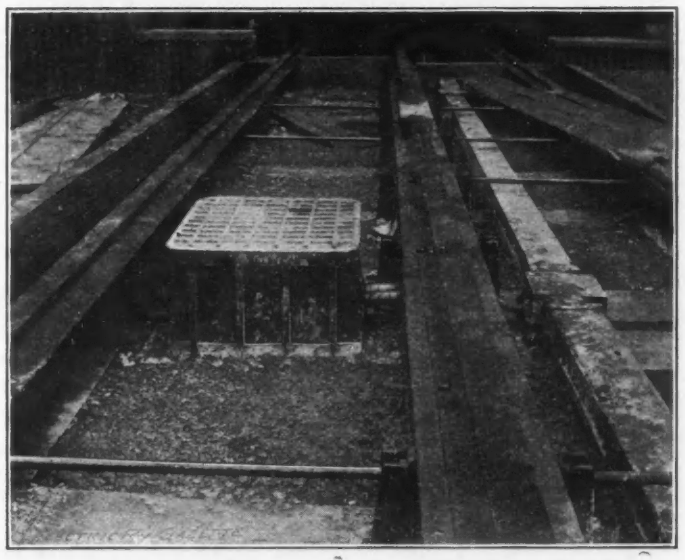


FIG. 2.—VIEW OF ROAD-BED.

form of electric conduit, which lines do not comprise more than 15 miles of the 985 laid in Great Britain.

(3) Electrically and mechanically there is no difficulty in working it anywhere, and there is an arrangement for supplementing the magnets by means of storage batteries, which controls in an emergency the switches in the junction-boxes should the magnet from any cause lose its power.

(4) The cost of working should not be more than that of lines worked by means of overhead electric wires, which in the South Staffordshire line is stated to be only slightly above 4d. per mile run.

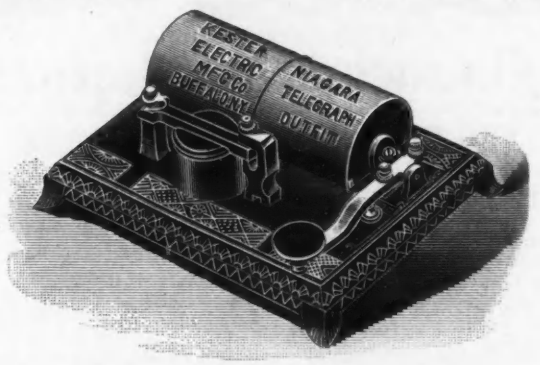
(5) The cost of maintenance, given proper care in original construction, and ordinary careful supervision, should be small and much less than for any system of overhead electric lines.

(6) The cheapness of its construction and low cost of working makes it available for use in districts where the cost of building an open slot electric conduit would render the installation of such a conduit system impossible.

(7) In conclusion, I have no hesitation in stating that such a system is specially fitted for use in large cities where the movement of traffic is very considerable, and the inconvenience attending the working of other systems of transport are so well known, whether the mode of traction be by horses, locomotives, overhead wires, etc.

The Niagara Telegraph Outfit.

The accompanying illustration shows a new telegraph outfit manufactured by the Kester Electric Manufacturing Company, of Buffalo, and is particularly adapted for learners and students. The apparatus is mounted



AMATEUR TELEGRAPH APPARATUS.

on a neatly japanned iron base with a nickel-plated key. The battery is contained in the base where it is hermetically sealed; the manufacturers state that the battery will retain its strength from one to three years depending upon the amount of work required of it. The apparatus illus' trated is intended more particularly for local use in learning, but it is furnished in another combination suitable for use with short lines.

The First Westinghouse-Baldwin Locomotive.

The Westinghouse Electric & Manufacturing Company has received the first electric locomotive manufactured under the arrangement entered into some time ago between the Westinghouse Company and the Baldwin Locomotive Works of Philadelphia. In appearance the locomotive is much different from the steam locomotive, and it is also claimed to include radical departures in construction from every electric locomotive hitherto manufactured. It is 38 feet long and 9 feet across. All the operating parts of the locomotive have been placed on the truck, and the body of the car will only contain the controlling apparatus, and can be utilized as a receptacle for such appliances as are usually carried by any train. It may also be used as a freight or baggage car.

One of the characteristic features of the locomotive is in the truck which has eight wheels, 42 inches in diameter. There will be four motors of 200 horse-power each connected to the axles of the locomotive. Thus the entire weight of the locomotive will be placed upon the truck, thereby becoming available for adhesion. This feature of construction will be readily recognized as a very advantageous one over locomotives, where only small percentage of the weight is available for adhesion.

The locomotive completely equipped will weigh 160,000 pounds. The motors will be geared, which method has been decided upon so as to enable the company to use more efficient and durable motors and also greatly reduce the cost of the locomotive. It is stated that while the electric locomotive used in the Baltimore tunnel cost $50,000, the Baldwin-Westinghouse locomotive will cost less than one third of that amount, and yet it will be able to accomplish the same work.

The Baldwin-Westinghouse combination is constructing engines for all kinds of purposes. The one described here is the regular passenger engine, rated at 1000 horse-power. Then there will be locomotives made to be used in mines. The latter will have six driving-wheels and the superstructure will consist of a sheet-iron cab. The switching locomotives will also have a cab as a superstructure. There will also be manufactured locomotives for tunnel work, suburban traffic and rack locomotives, as well as those for elevated railways.

It is expected that within a few days the second locomotive, as completed by the Baldwin people, will be received at the East Pittsburg factory of the Westinghouse Electric & Manufacturing Company. This last one will be of the elevated railway type, and resemble in appearance a car of the Manhattan Elevated Railway of New York.

As far as the speed of these new locomotives is concerned, it is stated that the motors have been geared to produce a speed of 75 miles an hour, although it may reach 125 miles an hour if demanded. All the locomotives will be equipped with air-brakes, which will be operated in the usual manner by an air pump, which is underneath the car, and driven by an electric motor.

All these locomotives have been designed so as to be utilized with any method of electric traction. They can be used with the trolley system, the third-rail system, the Westinghouse electromagnetic system, and also in connection with polyphase systems.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 15, 1896.

AMERICAN BELL.—It has been officially denied that the directors of the Bell Company have voted to increase the capital stock by 5000 or 6000 shares. It is understood that an issue of additional stock is being considered, but no definite official action has been taken.

EDISON ILLUMINATING OF NEW YORK, in the annual report, gives gross station earnings for 1895 as being $1,554,822; operating expenses were $541,051, leaving net station earnings of $1,003,771. The income from other sources was $130,408, and the office expenses, dividends, interest, taxes, etc., aggregated $963,181, leaving a surplus of $171,000. The company's business has increased steadily year by year, and the net earnings have increased in greater ratio than gross receipts.

GENERAL ELECTRIC.—Messrs. Samuel Carr, T. L. Livermore and Edwin F. Atkins, the committee to protect the General Electric preferred stockholders' interests, have not as yet formed any specific plans. They started out with the endorsements of stockholders representing 12,000 shares. Since the general notice has been sent to all preferred shareholders, favorable responses are coming in rapidly. The committee feels that concentrated interests can best treat with the directors of the company. The preferred stock of the General Electric has been purchased by small investors throughout New England. With the reported business of the company it is felt that 7 per cent. can easily be paid on the $4,200,000 cumulative preferred. The committee will endeavor to ascertain the legal status of the preferred stock as to whether it can be reduced; if not, to protect the stockholders in their position, and if it can, to see that it is reduced as little as possible. The company passed the preferred dividend about three and one half years ago, but now is doing a good business and has considerable cash on hand. It is felt that with the common stock selling at about $32, the preferred is worth more than the current price of 60 would indicate.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	93	96
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	32	32½
Electric Storage, pref	100	33	33½
General Electric	100	30⅞	31
General Electric, pref	100	60	62
Westinghouse Consolidated, com	50	29	31
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	204	204½
American District Telegraph	100	33	40
American Telegraph & Cable	100	92	94
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60¾	..
Gold & Stock Telegraph	100	105	..
New England Telephone	100	89½	90
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	85¼	35⅜

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	18	18¼
Brooklyn Traction	100	8½	10
" " pref	100	49	51
Buffalo St. Ry	100	72	74
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	45	48
Hestonville	100	49	50
Long Island Traction, all pd	100	21	21¼
New Orleans Traction	100	17	19
" " pref	100	63	66
North Shore Traction	100	29	33
" " pref	100	79	82
Rochester St. Ry	..	27	35
Steinway, Ry	..	49	..
Union Traction, rcts $5 pd	..	11¼	11⅜
West End, Boston	100	68	68½
" " pref	100	93	..
Worcester Traction	100	14	16
" " pref	100	85	89

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	81	83
Buffalo St. Ry. 1st con. 5s	100	104	107
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.

THE TRACTIONS.—The tendency of all the traction stocks this week has been upward, and prices, in spite of limited trading, shows a very general advance.

BROOKLYN TRACTION securities have been about the only exceptions. During the early part of the week the common stock advanced to around 10¾ but reacted toward the close, and is now offered at about 9½. The decline and apparent weakness are variously attributed to the prevailing uncertainty regarding the Brooklyn-Nassau lease and the delay in the publication of the terms.

BROOKLYN RAPID TRANSIT securities have been issued during the week, and trading in the stock has taken place as high as 23¾, and in the bonds around 82. The original subscriber to 1000 shares of Long Island Traction stock can now, provided he has paid all assessments and figuring in his interest, etc., see his way clear to obtain something like his original outlay should he dispose of his Brooklyn Rapid Transit securities. On a total cost to him of $27,312 he would receive 595 shares of new stock and ten bonds, which, figured at 23 for the stock and 81 for the bonds, show a loss of $5527.

BUFFALO RAILWAY stock has been selling between 72 and 73 during the week. A compromise will, it is said, be arranged between this company and the Buffalo Traction Company whereby the two roads will work in harmony.

COLUMBUS STREET RAILWAY COMPANY reports for January an increase of $3221 in net earnings. There exists a somewhat better demand for the stock at fractionally higher quotations.

THE NIXON COMMITTEE.—The report of the committee appointed by the Assembly to investigate the capitalization, operation and construction of street railways throughout the State has been presented. The committee finds that the railways, in many instances, are largely over-capitalized, and recommends that in future the amount of stock and bonds to be issued shall not exceed 50 per cent. above the actual cost of the property, etc. It also recommends that all franchises be disposed of at public auction to the company offering the lowest rate of fare and that the franchise be issued for a limited number of years. A bill is advocated which shall compel a company to sell 30 tickets for $1 during certain hours of the day, whenever the road is enabled to pay its fixed charges and a dividend of 5 per cent. on its stock. The committee does not favor the municipal ownership of railways.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 17, 1896.

THE INTERIOR CONDUIT & INSULATION COMPANY has absorbed the recently organized Reute Conduit Company. Mr. Ruete and Mr. Greenfield will hereafter be connected with the Interior Conduit Company.

THE C. J. FIELD COMPANY in its new offices in the Taylor Building, 39 Cortlandt Street, will continue the business in consulting and constructing engineering on railway and power work, in which line it played such a prominent part, having been connected with the building of a large number of the best power plants in the country.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 14, 1896.

MESSRS. REYNOLDS & CO., New Haven, Conn., manufacturers of machine screws, is one of the oldest firms in existence in this particular line, and is doing considerable business in its specialty with electrical manufacturing establishments. Secretary W. H. Reynolds is a most agreeable gentleman of manifest business abilities.

THE SEWING MACHINE CABINET COMPANY, of Bridgeport, Conn., is possessed of admirable facilities for the manufacture of telephone and electrical cabinet work. Telephone and electrical companies will consult their interest by keeping these facts in mind, and also the name of the company's popular and accommodating secretary, Mr. George Irving.

THE BRIDGEPORT BRASS COMPANY, Bridgeport, Conn., is manufacturing a torch for the use of linemen, which is highly spoken of. It was formerly a prominent manufacturer of bare and insulated wire, and it is thought will soon again enter this field. Mr. J. F. Kingsbury, Jr., the executive manager of the company, has had a wide experience in this line.

THE WILMOT & HOBBS MANUFACTURING COMPANY, of Bridgeport, Conn., is now quite settled in its new factory. The company continues to manufacture gongs for electric bells, and also a dynamo for electro platers, as well as oilers and other specialties, which have a large sale in the electrical field. Mr. F. H. Wilmot is the executive manager of the company, assisted in the details by Mr. F. R. Kenyon.

AT THE NEW ENGLAND RAILROAD CLUB'S monthly meeting and dinner, held in Wesleyan Hall, Boston, last Wednesday evening, Mr. James F.

McElroy, of the Consolidated Car Heating Company, of Albany, read an interesting paper on some of the mysteries of the electric motor, which was accompanied by illustrations. Mr. L. A. Parker read a paper on the electric equipment in the Belt line tunnel at Baltimore.

THE GENERAL ELECTRIC COMPANY'S employees in Lynn dined at the Revere House, Boston, last Saturday evening, Feb. 8. About 50 persons were present, and General Manager Mr. W. C. Fish presided. The guest of the evening was Mr. John Riddle, mechanical engineer of the company in New York. Prof. Thompson made an interesting speech on "The Cathode Ray," in which many interesting facts were brought to light.

THE ANSONIA ELECTRICAL COMPANY, Ansonia, Conn., finds its business constantly increasing, especially in the direction of its Shield brand moisture-proof compound insulated wire, Hercules trolley wire, and its extensive line of house goods. Vice-President and Manager Thomas Wallace, Jr., Secretary Franklin B. Platt, and Treasurer L. F. Anschutz are a strong business triumvirate, and all of them are well known to the electrical trade generally.

THE MASSACHUSETTS LEGISLATURE, now in session, is not an exception to its predecessors in the number of bills submitted bearing upon electrical and gas matters. The latest movement is a bill seeking the consolidation of all the lighting companies in Boston, and in the event of the various companies failing to come to an equitable agreement, empowering the gas and electric light commissioners to devise and direct such union for the most efficient and economical administration in the interests both of the stockholders and the general public.

THE DICKERMAN EMERY WHEEL & MACHINE COMPANY, Bridgeport, Conn., although in business only about a year, is doing a very satisfactory business in its specialty of tool grinding machinery. These tool grinders are adapted for use by electrical companies, and are the latest and most efficient machines of this character. They have but to be seen to be appreciated. Inventor Dickerman, and Treasurer and Business Manager Strickland, both young men of energy and push, have every reason to congratulate themselves over the present condition and future prospects of the company.

MR. W. C. BRYANT, of the Bryant Electric Company, Bridgeport, Conn., is one of the most thoroughly practical men in his line. He was a central station manager in the early days of electric lighting. This is perhaps one reason why the manufactures of the Bryant Company are so admirably adapted to the conditions to be met in actual practice in the operation of an electric lighting plant. Mr. Bryant is, moreover, an exceptionally good business man, as is also President Eaton (both of whom, by the way, we were glad to meet on a recent business trip), so that it is not difficult to account for the success of the Bryant Electric Company.

MR. ROBERT S. BROWN, secretary of the New Britain Machine Company, New Britain, Conn., which manufactures the well-known Case engine, was gratified to receive not long since an unsolicited letter from Savannah, Ga., saying of a Case engine that has been in constant use for 14 months driving a Lundell dynamo of 4.6 kw: "It has not cost one cent for repairs, and it is a delight to the mechanical eye to see it do its work so quietly." Mr. Brown is a splendid example of the younger element in business, and the success of the New Britain Machine Company under his management demonstrates the thoroughness with which he has mastered both the practical and business sides of the company's manufactures.

COL. SIMEON J. FOX, president of the National Pipe Bending Company, New Haven, Conn., may well feel proud of the handsome record his company has made in the introduction of the well-known "National" feed-water heater. At the close of the year 1895 the "National" heaters in use represented about 700,000 hp, and had been adopted by over 500 central stations and other electrical plants. The system is too well known to require special mention. Its plain and common-sense principle of heating the feed-water, the excellent construction and the economical advantages it offers, combined with the low price at which it is sold, have made it as popular in foreign countries as at home. It was our pleasure a few days ago to meet Col. Fox in his new and commodious factory. We found him as full of vigor as ever, and everywhere about the establishment there were abundant manifestations of business activity.

THE RECENTLY COMPLETED SESSIONS FOUNDRY, at Bristol, Conn., is so perfect in its appointments that it is a pleasure to visit it. This extensive industrial plant was dedicated under most favorable auspices, the occasion being honored by the presence of Gov. Coffin, of Connecticut, and upward of 700 representatives, not only of the manufacturing interests of Connecticut, but of other sections of the country. Mr. J. H. Sessions, the founder of the Sessions Foundry, and his son and business associate, Mr. W. E. Sessions, who together are its proprietors, may well feel proud of the handsome and lasting monument they have built to themselves in this modern establishment. The Sessions Company enjoys an enviable reputation in the manufacture of iron castings for electrical purposes, and has always done a large business with electrical manufacturing companies, which it is now in a better position than ever to serve.

THE NEW HAVEN CAR REGISTER COMPANY has materially beautified its executive headquarters by the addition of a handsome private office and directors' room. Mr. Willis M. Anthony has been elected president of the company to succeed Mr. H. B. Ives. Mr. Anthony has for a long time been one of the largest stockholders, and his active connection as president will undoubtedly be to the benefit of the company. Vice-president and General Manager F. Coleman Boyd, and Secretary and Treasurer John S. Bradley still retain their respective positions. Business generally with this company has never been so good as at the present time. This rapid and extended adoption of the New Haven fare registers is regarded by some as astonishing, but when the excellence of its manufacture, together with pushing and careful management are considered, this fact is not at all remarkable. The single, double and triple registers, and other ideas of simplicity and merit, in keeping with the demands and improvements in electric railways, entitle this company to the motto "Prompt, Progressive and Prosperous."

MR. J. G. NOYES, manager of the National Electrical Manufacturing Company, Milford, Conn., although comparatively young in years, is considerable of a veteran in electrical work. In the days seemingly long ago, in the light of subsequent developments, he was in charge of the electrical department of the New Haven Clock Company, out of which grew the National Electrical Manufacturing Company, and which continues virtually in the same line of work in connection with the manufacture of telegraph and district messenger supplies, fire-alarm boxes and supplies and electrical specialties generally. To-day it boasts of a fire-alarm and police signal system which has been adopted by some of the larger cities and which it is claimed is not second to any system in existence. The company has also accomplished the successful manufacture of electrical heating and cooking apparatus. In brief, Mr. Noyes does not hesitate to undertake experiments in almost any line of electrical work. From the social standpoint, Mr. Noyes is most attractive and agreeable, and we shall not soon forget the pleasant hour spent in his charming home in Milford, during a recent visit.

WASHINGTON NOTES.

WASHINGTON, D. C., Feb. 10, 1896.

THE SCRAMBLE OF PROPOSED TELEPHONE COMPANIES for a franchise to operate in Washington is getting interesting. These companies are knocking at the door for an opportunity to divide the business with the local company. They are the Standard, the Home and the Columbia. Since the Commissioners reported adversely upon the general proposition to charter another telephone company, the would-be competitors have been uneasy. Several hearings have been held, with a view to a reconsideration, but up to this time the Commissioners have not indicated a disposition to change their action.

A BILL HAS BEEN INTRODUCED by Mr. Frye in the Senate last week relating to the requirements of vessels propelled by electric motors. It requires all vessels above 15 tons burden, carrying freight or passenger, for hire, and propelled by such motors, to be made subject to all of the provisions of the revised statutes of the United States relating to the inspection of hulls and boilers and requiring engineers and pilots, and that all vessels so propelled, without regard to tonnage or use, shall be subject to the same regulations as steam vessels in passing each other, and also subject to the same provisions relating to lights for signals, steering and sailing rules, as the Board of Supervising Inspectors shall, by their regulations, deem applicable and practicable for their safe navigation.

CHIEF JUSTICE BINGHAM in delivering an opinion on the Potomac Electric Light case, recently argued before him, denied the right of the Commissioners to grant the permits authorizing that company to connect Georgetown with Eckington by an overhead electric line, and he based his decision upon the fundamental principle that such concession of public ways for private uses can only be made by the Commissioners under specific directions from Congress. Justice Bingham said, in effect, that the Commissioners have no more right to authorize the construction of the electric light lines proposed by the Potomac Company than they have to authorize the Tenleytown Railway Company to build a street car line over the same route. In concluding his opinion Judge Bingham adverted to the importance of the matter. He said it was of the utmost moment that the question should fully determine just what powers the Commissioners have in permitting the occupancy of the street, in allowing poles or other obstructions to be erected, or having the streets dug up for laying pipes or poles. In his view they had not primary authority to authorize any of these things. They must have the sanction in each case of a special act of Congress. The Potomac Light Company's permit from the Commissioners is therefore rendered valueless by Justice Bingham's decision.

MR. NEWLANDS in a recent speech in the House of Representatives on the subject of opening to public competition the lighting of the streets of Washington by either gas or electricity stated that the light of the future was the electric light. He referred to the water power at the Great Falls, and proceeding said: "Now, it seems to me that this is the time, while electric lighting is in its infancy, and while no corporation of that kind has yet any very large vested right in this community, to determine the question whether the municipality itself shall not own an electric-lighting plant and whether it cannot operate such a plant in connection with its water system to the great advantage of the District and with great economy to the taxpayers. I am quite sure that the District Commissioners, if they are given authority, will inaugurate a system of electric lighting vastly superior to any that would be provided by a private corporation under the provisions of this bill, for I take it that no private corporation will invest any large amount of money in an efficient system of lighting with the threat hanging over its head, as provided in this bill, that Congress may, whenever it sees fit, forfeit the right; in other words, that the privilege of using the streets may be taken away while the property invested in the improvements still remains there. It seems to me that the wise, the rational, the prudent solution of this question is to take the District Commissioners into the confidence of Congress with reference to this matter and devise a system of municipal lighting by electricity, and not to provide for the destruction of the streets of Washington by giving the Commissioners power to grant to some new corporation, or to some individual, the right to lay down new gas mains and electric light conduits."

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Feb. 14, 1896.

KUNKEL & BOWERS, Davenport, Ia., have entered the electrical field as engineers and contractors, and will also do repairing of every description. Among the specialties of the new firm are efficiency tests of central stations and isolated plants.

THE ELECTRIC APPLIANCE COMPANY has established quite a reputation for bringing out original advertising novelties. Its latest scheme in this line is certainly a good one and consists of a complimentary duplicate order book. The book consists of 50 original and duplicate order sheets bound in

a special cover such a manner that the customer has an impression copy of each written order made at one writing. The books are furnished complete with carbon paper ready for use, and will be sent on application.

Canadian Notes.

(From Our Own Correspondent.)

MONTREAL, Feb. 10, 1896.

ST. THOMAS, ONT.—Tenders for lighting the streets by electricity or gas are invited.

LANARK, ONT.—A bonus of $10,000 for an electric railway between Perth and Lanark has been granted.

BROCKVILLE, ONT.—There is a movement on foot to connect Kingston, Gananogue, Rockport and Brockville, Ont., by an electric railway.

LENNOXVILLE, ONT.—There is a good deal of talk in Lennoxville about the advantages of having an electric railway between that town and Sherbrooke, Que.

SEAFORTH, ONT.—The townspeople of Seaforth, Ont., are going to install an electric fire alarm, purchase additional hose, and generally improve their fire department.

GALT, ONT.—All the work on the Hespeler, Ont., extension of the Galt, Preston & Hespeler line is now complete. Government Inspector Ridout went over the line on Jan. 24.

YARMOUTH, N. S.—The Yarmouth, N. S., Telephone Company is stringing wires for the use of the Coast Railway Company, which will be operated by telephone instead of telegraph.

TORONTO, ONT.—The Toronto & Suburban Electric Railway is completing plans for extending its line to Lambton and Islington, a distance of three miles beyond the present terminus.

BELLEVILLE, ONT.—The County Council have granted permission to the Belleville Traction Company to construct an electric railway one and one half miles in length, from the city limits westward.

AYLMER, QUE.—The Deschenes Electric Company, Aylmer, Que., has been incorporated to build and operate works for the distribution of electricity. E. A. and John Conroy are among the promoters.

UXBRIDGE, ONT.—The people of Uxbridge are listening to reports as to the possible failure of their electric railway scheme to go through, and they are wondering if they are liable for the second installment on the subscribed stock in case it does not.

MONCTON, N. B.—The city council of Moncton, N. B., has unanimously decided to petition the New Brunswick Legislature for the cancellation of the charter of the Moncton Electric Tramway Company, for failure to fulfil the conditions of its charter.

OTTAWA, ONT.—M. T. Viau, of Hull, has sold his franchise for building an electric railway from Hull to Aylmer and Gatineau Point, and for electric lighting of the city of Hull, to a company of Ottawa capitalists. Work will be proceeded with early in the Spring.

ROCKTON, ONT.—Rev. Dr. Burns and Engineer Power, who are promoting the electric road to run from Hamilton to Waterloo, held a meeting at Rockton, Ont., recently. The citizens are heartily in favor of the scheme, and no doubt "something will be done."

LONDON, ONT.—A St. Thomas gentlemen is said to be negotiating for the purchase of the St. Thomas street railway from Hunt & Cameron, of London, Ont. A price has been set on the franchise, and it is not unlikely that the road will pass into new hands on the first of March.

HAMILTON, ONT.—The Lincoln County Council has granted the Hamilton, Grimsby & Beamsville Electric Railway a 20 year franchise for running power over the Queenston & Grimsby stone road, and work will be commenced at once to build the extension from Grimsby to Beamsville.

THE SUPREME COURT OF OTTOWA has dismissed the appeal of the city of Vancouver. This upsets the by-law passed by the ratepayers in 1894, authorizing a civic electric lighting plant. The council has now passed a by-law providing for the lighting of the city by the Western Electric Company.

PORT MEDWAY, N. S.—A charter has been obtained to build an electric railway from Greenfield to this place, a distance of about 16 miles, along the Medway river. The company who are promoting it purpose building three pulp mills, working the gold mine at Greenfield, also going into lumbering and milling.

THE MANITOULIN & PACIFIC RAILWAY COMPANY is making application for an Ontario charter to build an electric railway from a point in Manitoulin Island to a junction with the Canadian Pacific Railway between Sudbury and Algoma Mills, with power to operate a ferry or build a bridge at Little Current.

ST. CATHARINE'S, ONT.—The Lincoln Radial Electric Railway Company is applying for a charter to build lines from St. Catherine's to the villages of Jordan, Beamsville and Grimsby, with a branch to Smithville and to Port Dalhousie and to Queenstown, with power to buy the Lincoln Street Railway Traction & Light Company, Limited.

MONTREAL, QUE.—The Montreal Street Railway proposes to have no desire to build a line up the mountain; they would only do so in order to prevent some one else doing it, and at the earnest request of the Council. G. C. Cuningham, manager, says the line would cost $100,000, and as it would be open only four months in the year, the returns could not be such as to make it a profitable investment.

CORNWALL, ONT.—Cornwall is to have an electric street railway. The contractors are W. Harper, of New York, and D. H. Star, of Montreal. The contract was signed Jan. 23, and tenders have been called for 2000 cords of stone for the roadbed, to be delivered immediately. The contractors expect to have the cars running by the first of June. W. R. Hitchcock was the promoter of the scheme. A line is to run from the Grand Trunk station to the Canada Cotton, Stormont Cotton, Cornwall Manufacturing, and Toronto Paper Companies' mills. The company will likely secure the Grand Trunk freight, and will keep the road between the rails and 18 inches on each side of the rails in condition.

THE BERLIN & WATERLOO STREET RAILWAY is undergoing changes. The controlling interests, held by Mrs. Burt, of New York, has passed into the hands of W. H. and E. Carl Breithaupt. This will have a good effect on the road, as the new owners are citizens of the town and greatly interested in its progress. T. M. Burt and F. E. McLellan retain their places in the management, but E. C. Breithaup is president.

English Notes.

(From Our Own orrespondent).

LONDON, Feb. 5, 1896.

MUNICIPAL ELECTRIC LIGHTING IN LONDON.—At their last meeting the local authority reponsible for the good government of Hackney, a manufacturing, densely populated neighborhood in the northeast of London, decided to lay down a combined electric lighting and dust-destructor system at a cost of about £80,000.

CAPITAL EXPENDITURE ON ELECTRIC LIGHT UNDERTAKINGS IN THE UNITED KINGDOM.—According to the latest information, a total of £8,000,000 sterling has actually been spent up to the 31st of December last on electric supply undertakings in this country. Of this expenditure, £5,600,000 is due to companies and £2,400,000 to local authorities.

ADOPTION OF THE WESTINGHOUSE CLOSED-CONDUIT SYSTEM AT LEEDS.—Acting on the advice of Dr. John Hopkinson, a committee of the Leeds Town Council has decided to recommend the adoption of the Westinghouse Closed-Conduit System by way of experiment on a section of the tramway lines, which will shortly be taken over by the municipal authorities.

ELECTRIC TRACTION ON THE UNDERGROUND RAILWAY.—At the last meeting of the Metropolitan Railway Company, the chairman, in connection with the efforts which the company is making to improve the ventilation of its pestiferous tunnels, stated that the directors had by no means given up the idea of adopting electric traction, but were awaiting a really workable offer from responsible people. Hitherto there had not been any one bold enough to undertake to run with regularity their present heavy and lengthy trains. They had, however, just received an offer from an electric supply company, and if they were advised that it contained a workable idea, they would not hesitate to adopt electric traction.

Miscellaneous.

MESSRS. EYANSON & ARMPRIESTER, of Philadelphia, say they heard from their announcement in the New Year's number of THE ELECTRICAL WORLD not only from all over the United States but also from England, Switzerland and Japan.

Trade and Industrial Notes.

CROSBY BROTHERS, 44 North Fourth Street, Philadelphia, have increased their business to such an extent that they have been obliged to take very much larger quarters on the fourth floor of the same building. They are now doing a big business in knife switches and tablet boards.

THE LESCHEN-MACOMBER-WHYTE COMPANY, 19 South Canal Street, Chicago, has taken charge of the Western business of the A. Leschen & Sons Rope Company. A complete stock of bare and insulated copper wire for telephone, telegraph, electric railway and electric lighting purposes will be carried.

THE ST. LOUIS CAR COMPANY, it is rumored, will establish a branch of their extensive plant at Homesburg, or in some other surburban town of Utica, N. Y. A visit was recently paid to the latter place by Mr. P. M. Kling, president of the company; George J. Kobus, vice-president, and G. P. Hickel, director.

SCOTT BROTHERS' ELECTRIC COMPANY, Detroit, Mich., in a recent catalogue describes a number of their specialties, which include new forms of an expanding wire guard, rosette, porcelain bug cut-out and adjustable electric lamp cleaner. The bug cut-outs are provided with thumb screws, which enable them to be re-fused in the shortest possible time.

THE HOME STUDY OF ENGINEERING.—The Institute for the Home Study of Engineering, of Cleveland, O., gives, in a compendious catalogue, detailed information relating to its various courses of study, the pamphlet including a number of reprints of lesson sheets. The special pieces of apparatus which the institute uses in connection with the instruction are also illustrated and described.

SLOW-SPEED ELECTRIC MOTORS.—The Diehl Electric Company, Elizabethport, N. J., in a handsomely printed circular gives several excellently executed illustrations of its slow-speed motors, accompanied by descriptions and data. The armature of the motor encircles and revolves around the field magnets, thus securing high efficiency and low speed as well as greatest durability. The 1-hp motor has a speed of 950 revolutions per minute, that of larger sizes being correspondingly low.

MICA AND MICANITE.—The foreign business of the Mica Insulator Company, 218 Water Street, New York, has grown largely during the last six months, so that it has been compelled to increase its facilities for manufacturing its well-known insulation "Micanite." The company has also made additions to their factory in London. European manufacturers of electrical machinery are using "Micanite" largely in the construction of their various designs of apparatus, and the company is to be congratulated upon the success with which its insulation has met in foreign countries.

ELECTRICALLY OPERATED PUMPS.—The Knowles Steam Pump Works, 93 Liberty Street, New York, devote a 44-page catalogue to electric power pumps of which no less than 14 different types are illustrated. Each of the different pumps is well described, the various data relating to the pumps of

different power being tabulated. The book is well printed on an extra quality of paper and the illustrations are all wood-cuts, thus forming a most praiseworthy exception to most recent catalogues, containing as they do half-tone engravings which are next to useless for illustrating machinery.

HARRY S. SMITH, 607 Chestnut Street, Philadelphia, Pa., installed the incandescent plant of the Walton, the new hotel opened in Philadelphia last week. The hotel is wired for about 5000 incandescent lamps, the power being furnished by three 100-kw Crocker-Wheeler multipolar generators direct-connected with three Ideal engines. Eight Huyatt & Smith exhaust fans are direct-connected to electric motors. The Colvin interior telephone system is used and there are three high-speed Sprague passenger elevators. Among other important installations made under Mr. Smith's supervision in Philadelphia are the electrical equipment of the University, chemical laboratory and hospital, the League Island navy yard and Bartram apartment house.

WILLIAM W. DONALDSON, 215 North Calvert Street, Baltimore, has installed for the Smithsonian Institution at Washington, a "chloride" battery plant of 58 cells and 200 ampere-hours capacity, which is used as an auxilliary to the dynamo and gas engine. The battery has a capacity of about 35 lights for 10 hours, which are used during the day when the dynamo is not running, and for lamps after 4 o'clock for all night work. A switchboard fitted with automatic trips and special switches makes it possible to use the battery by itself for operating lamps, and also to charge and discharge the battery while the dynamo is doing regular work. The battery current is used in all the experimental departments, and gives an unfailing source of power for all night operations. Great satisfaction is expressed by the committee, who, after an examination, ordered the plant accepted.

H. E. COLLINS & CO., Pittsburg, Pa., sole sales agents for the Cahall Vertical Water Tube Boiler, manufactured by the Aultman & Taylor Machinery Company, Mansfield, O., reports the following recent sales of Cahall boilers: National Chemical Company, Cleveland, O., 150 horse-power; Republic Iron Works Company, Pittsburg (fourth order), 250 horse-power; Municipal Electric Lighting Plant, London, O., 250 horse-power; Voight Brewing Company, Detroit, Mich., 500 horse-power; Michigan Alkali Company, Wyandotte, Mich. (fourth order), 300 horse-power; Jefferson Coal Company, Coal Glen, Pa., 500 horse-power; Ohio Iron Company, Zanesville, O., 500 horse-power. The boilers for the Republic Iron Works are for the utilization of waste heats from heating furnaces, those for the Ohio Iron Company are for blast furnace gas and the other orders mentioned are for boilers of the direct-fired type. Collins & Co. have just issued a little circular showing the results of a comparative test made on the Cahall and other leading types of boilers, which should prove interesting reading to intending purchasers.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 4, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

554,124. ELECTRIC BATTERY; C. J. Hirlimann, Fort Lee, N. J. App. filed Oct. 25, 1895. The combination with a jar having interior flanges, and a zinc element extending around the interior of the jar, of a carbon element comprising two cup portions, having perforated walls, a flange on the upper portion of the carbon element, adapted to rest on the flanges in the jar, and two ears on the carbon element to which line wires may be connected.

554,125. TELEPHONE SYSTEM; W. A. Houts, Parker, S. D. App. filed Dec. 24, 1894. A call box provided with a revoluble indicator, a revoluble wheel, a spring having its ends secured to the wheel and indicator respectively, and arranged to be wound up by the rotation of the indicator relatively to the wheel, and circuit-breaking mechanism operated by the wheel.

554,130. FUSE HOLDER AND LIGHTNING ARRESTER; H. A. Lewis, Norristown, Pa. App. filed Jan. 17, 1895. A binding post provided with a slot and a spring clamp having one member stationary relatively to the post and a movable spring member extending into the slot of the post.

554,138. MECHANICAL AND ELECTRICAL DEVELOPMENT AND STORAGE OF WIND POWER; W. L. Negbaur, Brooklyn, N. Y., and J. J. Feely, Walpole, Mass. App. filed Oct. 9, 1895. The improved device for the utilization of wind-power consisting of a wind-motor, and a driving shaft operated thereby, a driving shaft provided with a device for storing energy, and an intermissive clutch connection between the two shafts.

554,221. ELECTRIC SNAP SWITCH; G. W. Hart, Hartford, Conn. App. filed Sept. 27, 1894. In combination, in a switch, a rotary shaft mounted on a base piece, the base with a series of steps arranged about the shaft, a spring secured to the shaft so as to turn therewith and with a resilient coil eccentric to the axis of the shaft, and with an end adapted to engage the stops, a switch-plate loosely mounted on the shaft and loosely connected to the arm of the spring.

UNITED STATES PATENTS ISSUED FEB. 11, 1896.

554,230. REGULATING PHASE RELATION OF ALTERNATING CURRENTS; E. J. Berg, Schenectady, N. Y. App. filed Oct. 8, 1895. The means for preserving the phase relation of current and electromotive force in alternating circuits, consisting of a current-actuated device and a watt mechanism opposed in their action, and means actuated thereby for restoring the phase relation when disturbed.

554,239. METHOD OF TRANSFERRING FEEDERS; J. Burke, Schenectady, N. Y. App. filed Dec. 24, 1894. The method of transferring a generator from one circuit to another of different potential, which consists in connecting it to the new circuit through a source of electromotive force while maintaining its connection with the old circuit, also through a source of electromotive force, and varying the relative values of such electromotive force until the potential of the new circuit is reached.

554,240. METHOD OF ELECTRICAL DISTRIBUTION; J Burke, Schenectady, N. Y. App. filed Dec. 24, 1894. The combination of two or more circuits or portions of a distribution system, with generators maintaining different potentials in such circuits, a number of dynamo machines running in unison, and coupled in series between the different potential circuits, and a source of current supply connected at a point between the armatures of said machines, and adapted to feed current to the first-named circuits at their respective potentials.

554,247. BATTERY; W. S. Doe, Brooklyn, N. Y. App. filed Sept. 18, 1894. In a battery cell, containing a depolarizing liquid, the vessel formed of the porous cup and a bottle-shaped top portion, sealed thereon, and having an opening in its top or shouldered portion, and a mouth provided with a closing cap, the carbon contained in such vessel, and a rod which is connected with the carbon, and extends vertically through, and is sealed in said opening.

554,263. ELECTRIC CABLE; T. Guilleaume, Mulhein-on-Rhine, Germany App. filed March 19, 1895. An electric cable comprising a main conductor, and a safety conductor, the latter being of such a character as to withstand less tensile strain than the main conductor, so that upon the safety conductor breaking the current is, by means of a suitable switch apparatus, diverted from the main conductor before the latter breaks.

554,270. THREE-WIRE ELECTRIC SYSTEM; E. M. Hewlett and W. B. Potter, Schenectady, N. Y. App. filed Sept. 10, 1895. In a three-wire system, the combination of compound-wound generators connected respectively to the positive and negative sides of the system, positive and negative equalizers, equalizing the flow of current on their respective sides of the system, and switches for throwing the machines from one side to the other.

554,275. METHOD OF AND MEANS FOR DETECTING GROUNDS; J. F. Kelly, Pittsfield, Mass. App. filed June 17, 1895. In a ground detector, two wings or sets of wings, each having the potential of one of the branches of the circuit in combination with a needle whose potential is maintained at zero lying within the influence of said wings.

554,276. CONTROLLER FOR DYNAMO ELECTRIC MACHINES; W. H. Knight, Lynn, Mass.. and J. W. Darley, Jr., Baltimore, Md. App. filed May 6, 1893. The method of changing motors from parallel series to parallel, which consists in shunting part of the motors from each series breaking the shunt, and placing the shunted part of the motors in parallel with the other part.

554,307. CONTROLLER FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Aug. 5, 1895. A controlling mechanism for electric motors, comprising a series-parallel controlling switch, having suitable circuits and contacts adapted to regulate the motors from rest to a certain speed, and an auxiliary switch adapted to modify the circuits so that the controlling switch may regulate the motors from rest to another or different speed.

554,321. ELECTRICAL MEASURING INSTRUMENT; E. Thompson, Swampscott, Mass. App. filed Nov. 12, 1895. In an electric measuring instrument, a coil or conductor, traversed by the current to be measured, placed in an inclined or angular position with respect to the shaft carrying the indicator and a second coil carried on said shaft and at an angle thereto and connected in shunt to the first coil, with means for bringing the indicator to zero when no current passes.

554,332. INSULATING JOINT; C. J. Carson, Chicago, Ill. App. filed Sept. 23, 1895. The combination with a uniting collar on the ends of two pieces to be joined together, a main locking collar engaging the collar on one of said pieces, and forming with an opening or chamber provided with an annular rim having teeth or corrugations to correspond with and engage those of said locking collar and adapted to be secured to the other piece to be united.

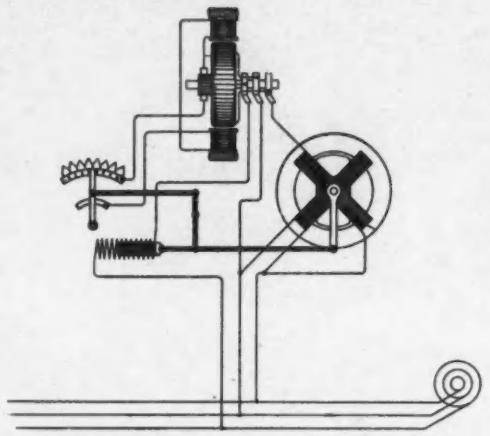
554,350. TROLLEY AND SWITCH FOR ELECTRIC RAILWAYS; L. L. Stimpson, Boston, Mass. App. filed May 2, 1890. A trolley pole sustained approximately in a vertical line by cords or tow-lines extending to the top thereof to the ends of the car on which it is placed.

554,353. ELECTRIC LOCOMOTIVE; C. F. Uebelacker, Cleveland, O. App. filed Sept. 6, 1893. In an electric locomotive the combination with a truck frame of an axle, of a transverse bar extending over the axle, springs between the ends of said transverse bar and the truck frame, a U-shaped frame mounted at one end on the axle, said frame comprising parallel arms and a connecting bar, the latter being disposed parallel with and in close proximity to the axle, a spring disposed between said last-mentioned bar and the transverse bar on the truck frame, and an electric motor mounted in the free end of the U-shaped frame, said motor being secured to the transverse bar on the truck frame, a gear wheel on the axle, a pinion on the armature shaft of the motor, and a casing for said gearing carried by the U-shaped frame.

554,365. ELECTRIC MOTOR; J. H. Guest, Boston, Mass. App. filed Dec. 23, 1893. In an electric railway motor, an armature consisting of a sleeve provided with polar projections, and mounted in an insulated man-

ner upon the car axle, and having its coil mounted in a fixed position independently of the axle.

554,369. COMMUTATOR BRUSH; O. P. Loomis, Bound Brook, N. J. App. filed Feb. 13, 1895. In a commutator brush, the combination of a set of layers or strips composing the brush, and a fastening device for securing the outer ends of said strips together, said device being insulated from said strips.



No. 554,230.—Phase Relation Regulator.

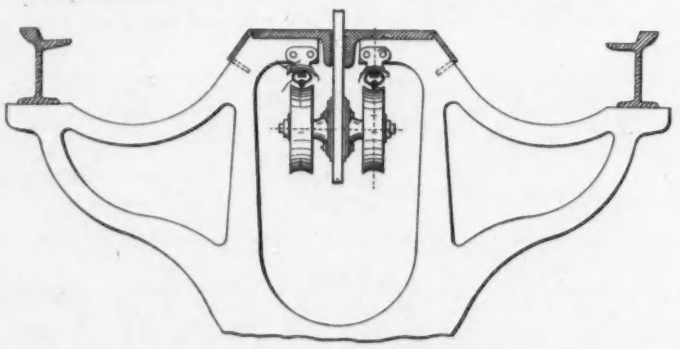
554,379. ELECTRIC LIGHT CABINET; E. L. Slocum, Pawtucket, R. I. App. filed March 21, 1895. In an electric light cabinet, the combination of a holding jar for the battery, the negative electrode provided with a flange, and the packing ring between the flange of the negative electrode and the top of the jar, with the case provided with the cover, the knob upon the cover adapted when the cover is closed to hold the flange of the negative electrode firmly against the packing ring to prevent leakage, the electric lamp and its connecting wire, and the drawer provided with a partition which serves to separate the electric lamp from the conducting wire when deposited in the drawer.

554,394. INSULATING JOINT; L. McCarthy, Boston, Mass. App filed Oct. 14, 1895. The improved process of manufacturing insulating-joints and the like, which consists in applying, during the assembling of the parts, a suitable quantity of dry-powdered insulating substance or compound at the places where air spaces are likely to be formed in the completed article, and subsequently rendering such substance or compound plastic and solid by the application of heat.

554,395. TELEGRAPH RECEIVER; L. E. Oehring, Chicago, Ill. App. filed July 20, 1893. In a telegraph receiver, the combination with an electromagnet and an armature lever, of a punch positively moved by said armature lever, to perforate the tape, and a releasing dog for permitting the return of the punch independently of the movement of the armature lever.

554,399. APPARATUS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed July 2, 1895. The combination with a telephone line, of a line spring jack upon each of several sections, of a multiple switchboard, and an answering spring jack at one of the sections having contacts adapted to be separated when a plug is inserted into the spring jack, and arranged to cut off the conductor extending to the line spring jacks.

554,414. AUTOMATIC CURRENT REGULATOR; S. C. C. Currie, New York, N. Y. App. filed May 23, 1895. The combination with an electric circuit, of a source of electrical energy, a controlling magnet, a variable resistance, an expansible apparatus operated by heat and controlling the resistance, and a second control magnet breaking the direct circuit from the magnet to line when the resistance has been increased to a determined amount.



No. 554,450.—Underground Electric Railway Conduit.

554,427. VOLTAIC BATTERY; S. R. V. Robinson, Brooklyn, N. Y. App. filed May 9, 1894. An electric battery composed of an exterior box, a porous cup in the same, a rubber-lined cover fitting tightly on the box and cup, a carbon plate in the cup, a zinc plate outside of the cup, means for supporting the zinc plate at some distance from the bottom of the box, studs arranged near the upper portion of the zinc plate, and against which the same rests, and an exciting solution in the cup and box respectively.

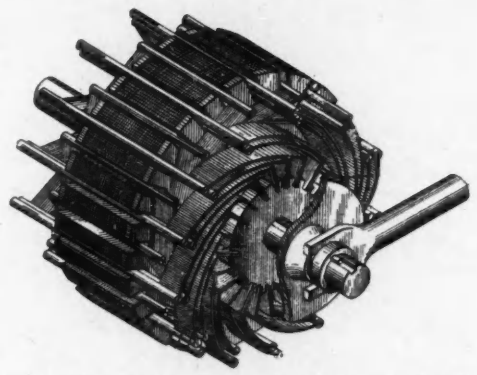
554,438. DISTRIBUTING BOX AND FUSE PLUG; P. S. Brown, Toledo, O. App. filed April 19, 1895. A fuse plug comprising a base portion of insulating material, a pair of oppositely arranged convergent contact strip depending from said base, a block of insulating material resting upon the case, provided with an aperture therethrough, a fuse strip extending through said apertured block and removably connected at each end with one of said contract strips, and a handle secured to said block.

554,450. UNDERGROUND CONDUIT FOR ELECTRIC RAILWAYS; W. S. Merkle, St. Louis, Mo. App. filed March 29, 1894. In an underground electric system the combination of a plurality of hangers, a conductor semicircular in cross-section, the flat face of which forms a contact surface, a cap plate semicircular in cross-section and provided with perforated side flanges and fixed to, but insulated from, said conductor, said hangers supporting said cap-plate, flexible insulating material having its edges bolted to said flanges of said cap-plate and a flat contact wire extending parallel to the said conductor, and supported by the said flexible insulating material.

554,505. ELECTRICAL BURGLAR ALARM; C. Coleman, Chicago, Ill. App. filed Nov. 20, 1895. In a burglar alarm, the combination with a signaling device and a meter adapted to control it, of an electrical circuit including said meter and extending from the office to the guarded structure and permutating rheostats arranged in said circuit and located at distant points.

554,508. AUTOMATIC CUT-OUT FOR ELECTRICAL CONVERTERS; W. J. Greene, Cedar Rapids, Iowa. App. filed Sept. 30, 1895. In an automatic cut-out for electrical converters, the combination with a suitable frame and bearings of a switch closer having a cylindrical body, a pair of opposite lateral arms, and a vertical gravity arm, solenoids adapted to act alternately on said lateral arms, a cylindrical switch closer, coupled to and moving concurrently with said first-named switch closer, and adapted to close the solenoid circuits alternately, and switches between said cylinders, having contact plates attached to the coupling of said cylinders, and adapted to open and close the main and secondary circuits.

554,542. ELECTRIC ARC LAMP; J. A. Seaverns, Boston, Mass. App. filed March 14, 1895. In an electric arc lamp, the combination with carbon holders and a clock mechanism adjusted to a predetermined rate whereby the holders are caused to advance toward each other, of a coil adapted to govern the clock mechanism, and cause an acceleration or retardation of its normal rate, whereby the arc may be continuously maintained.



No. 554,617.—Armature for Induction Motors.

554,557. ELECTRIC SWITCH; H. B. Whitehead, Memphis, Tenn. App. filed Aug. 29, 1894. In a switch the combination with a switch lever, of a detent therefore and an expansion wire having one end engaging with the detent lever, and a clamp engaging the other end of said wire, and comprising a slotted plate, a screw passing through said slot and an adjusting screw passing through a tapped hole in the upturned end of the plate and impinging against the first-named screw.

554,571. TROLLEY GUARD; J. H. Beazan, Milwaukee, Wis. App. filed March 19, 1894. The combination with a trolley arm and its wheel, of a pair of upwardly divergent guard arms pivotally supported upon the upper end of the trolley arm and its wheel, and arranged to extend at their upper ends considerably above the periphery of the wheel, downwardly extending projections upon said arms below their pivotal supports, an arm upon the rear side of the trolley arm terminating at a point substantially beneath the centre of the trolley wheel when the latter is engaged with the wire, and suitable connections between said extension and the extensions upon said guard arms, for normally sustaining the latter at substantially right angles to the wire.

554,617. ARMATURE FOR INDUCTION MOTORS; A. L. Cushman, Concord, N. H. App. filed March 30, 1895. In an armature for induction motors, a coil composed of an active high resistance portion and two or more low resistance portions, the high resistance portion and one of the low resistance portions being constantly in series, and means for cutting out the high resistance.

554,622. ELECTRIC GAS LIGHTER; H. G. Grier, Philadelphia, Pa. App. filed Nov. 7, 1895. The combination with a gas burner having a refractory mantle, and means for supplying a mixture of air and gas thereto, electric sparking devices disposed on the outside of the mantle, and means whereby a jet of the mixed air and gas is projected in proximity to the point at which the spark is formed by said devices.

554,631. CONDUIT FOR ELECTRIC CONDUCTORS; F. Fuller and J. M. Kinney, Boston, Mass. App. filed May 24, 1895. A conduit for electric conductors, consisting of a sheet of metal bent to form a tube by bringing its longitudinal edges together and having its inner and outer sides treated with an insulating and fireproof substance.

554,632. ELECTRIC HEATER OR RHEOSTAT; F. Kraemer and M. Kruger, Chicago, Ill. App. filed Jan. 7, 1895. A rheostat or electric heater, comprising a prepared carbon resistance stick hermetically embedded in a plastic body composed of one part of cement, two parts of sand and one part of water.